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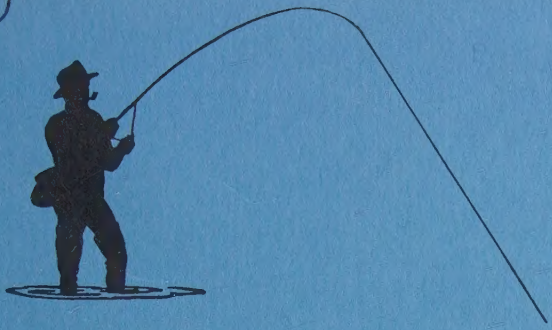

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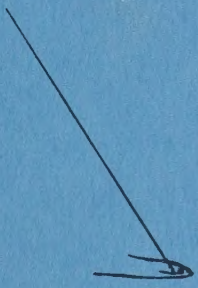

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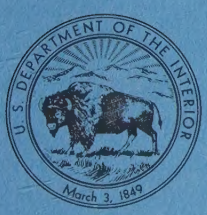

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Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of published articles on limnology, ecology, natural history and other fields of specialization are included when the subject has application to the conservation and management of sport fishery resources.

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17035. Houde, E. D. (Rosenstiel School of Marine & Atmospheric Sci., Univ. of Miami, Rickenbacker Causeway, Miami, Florida 33149). 1973. SOME RECENT ADVANCES AND UNSOLVED PROBLEMS IN THE CULTURE OF MARINE FISH LARVAE. Proc. of the World Mariculture Soc., 1972, Vol. 3, pp. 83-112.

Successful rearing of marine fish larvae depends on numerous factors, but a suitable food supply in conjunction with reasonably good water quality are the two factors that are of greatest importance. Most newly hatched marine fishes have mouths that are too small to begin feeding on Artemia sp. nauplii, but some copepod nauplii, rotifers, mollusk larvae, and dinoflagellates provide suitable food. Size of food organisms and the food level maintained in rearing tanks are important for initiation of feeding and for subsequent growth and survival. Optimum rearing temperatures need to be determined for each species to assure that growth is rapid during the larval stage. Both growth and survival of fish larvae are enhanced when a phytoplankton bloom is maintained in the rearing system. Larvae grow and survive better in large culture tanks than in smaller ones. Little is known about optimum stocking densities of eggs and larvae in rearing systems. Abnormal development of larvae is a common occurrence and can be attributed to stresses of the rearing tank environment. Diseases and parasites may affect survival of eggs and larvae. Energy relations have been determined for egg and yolk sac larvae but similar research is required on advanced larval stages. The variability in egg quality that will result from artificial spawning procedures will also be a factor affecting subsequent rearing attempts. (Auth.)

17036. Cairns, John, Jr., John W. Hall, Eric L. Morgan, Richard E. Sparks, William T. Waller, and Garson F. Westlake (Biol. Dept. and Center for Environ. Studies, Va. Polytechnic Inst. and State Univ., Blacksburg, Virginia 24061). 1973. THE DEVELOPMENT OF AN AUTOMATED BIOLOGICAL MONITORING SYSTEM FOR WATER QUALITY. Va. Water Resources Research Center Bulletin 59, 50 p.

A rapid biological monitoring system has been developed which measures changes in the swimming movements and breathing rates of fish. The monitoring system eventually may provide an early warning of developing toxicity in wastes or streams. In a series of laboratory challenges to the monitoring system, a harmless diurnal temperature change was detected as well as harmful additions of chlorine and zinc sulfate, emphasizing the necessity of follow-up physical-chemical measurements to determine the cause of a biological detection and to decide whether control measures are necessary. The monitoring system correctly differentiated an upstream spill of chlorine from a simulated in-plant spill of zinc sulfate. The sensitivity of bluegills to a simulated zinc sulfate spill (introduction of a sublethal concentration of 3 mg/l, as zinc) did not decrease after 37 weeks of exposure to a low zinc concentration (0.075 mg/l), indicating that rapid desensitization of fish exposed to industrial waste may not be a problem, at least with wastes that act similarly to zinc. The monitoring system correctly indicated a reduction in toxicity when 3 mg/l zinc was antagonized by an addition of calcium chloride, but did not detect a mixture of copper sulfate and zinc sulfate predicted to be at the threshold of detection. A harmless increase in calcium chloride caused no breathing detections. The further development and eventual use of the monitoring system in industrial plants and river basins to maintain water quality for multiple use are discussed. (Authors)

17037. Gas, Nicole, and Albert Serfaty. 1972. CYTOPHYSIOLOGY OF CARP LIVER (Cyprinus carpio L.). ULTRASTRUCTURAL MODIFICATIONS FOLLOWING WINTER STARVATION. [Cytophysiologie du foie de carpe (Cyprinus carpio L.). Modifications ultrastructurales consecutives au maintien dans des conditions de jeune hivernal). J. Physiol. Paris, 64: 57-67; Fish Health News, 2(4): p. 7.

Carp weighing 200-250 g were maintained for 6 months in fasting condition at variable water temperature, and used for the study of ultramicroscopic effects of starvation on liver cells. Cytologic changes were similar to those occurring in fasting endothermic vertebrates, but progressed at a much slower rate. Changes consisted of hydration of reticulum, swelling of chondriosomes, and glycogen decrease. -- S. F. Snieszko

17038. Chapman, G. (Western Fish Toxicology Sta., Nat'l Environ. Res. Center, Corvallis, Oregon). 1973. EFFECT OF HEAVY METALS ON FISH. In: Heavy Metals in the Environment; Proc. of Seminar conducted by Ore. State Univ., Corvallis, Fall Quarter 1972: Ore. State Univ. Water Resources Res. Inst. Report SEMN WR 016.73, pp. 141-162; Selected Water Resources Abstracts, 6(20): p. 65.

A review of literature with respect to the toxicity to fish of the heavy metals, zinc, copper, and cadmium, showed a wide range of values (for each metal), which were cited as 96-hr LC50 values, i.e., the concentration which kills 50% of the test animals in 96 hours. For zinc this range was 90 to 40,900 ppb; for copper 46 to 10,000 ppb; and for cadmium 470 to 9,000 ppb. Two general conclusions are that toxicity varies inversely with hardness, and that salmonids (trout and salmon) are more susceptible than most other common test species (primarily bluegills, Micropterus salmoides; and goldfish, Carassius auratus; and perhaps fathead minnows, Pimephales promelas.) Disregarding species and age, all of the other generally recognized factors which influence the toxicity of heavy metals to fish largely do so by influencing the rate of accumulation of the metal and, primarily, the rate of uptake of the metal. Thus pH, hardness and alkalinity, temperature, and dissolved oxygen level all affect the rate of uptake of the metal by changing either the biological availability of the metal by altering its form or by altering the rate and volume of ventilation of the fish.

17039. Schindler, D. W., H. Kling, R. V. Schmidt, J. Prokopowich, V. E. Frost, R. A. Reid, and M. Capel (Fish. Res. Bd. of Canada, Freshwater Inst., Winnipeg, Manitoba R3T 2N6, Canada). 1973. EUTROPHICATION OF LAKE 227 BY ADDITION OF PHOSPHATE AND NITRATE: THE SECOND, THIRD, AND FOURTH YEARS OF ENRICHMENT, 1970, 1971, AND 1972. J. Fish. Res. Bd. Canada, 30(10): 1415-1440.

Lake 227, a small lake with extremely low concentrations of dissolved inorganic carbon, was fertilized with PO_4 and NO_3 for 4 years, beginning in 1969. The additions increased natural inputs of phosphorus and nitrogen about five times. Phytoplankton standing crop increased nearly two orders of magnitude, and the Cryptophyceae and Chrysophyceae present in natural lakes of the area were replaced by Chlorophyta and Cyanophyta. The standing crop of phytoplankton per square meter was near the maximum which could theoretically be maintained by surface light, in spite of the low carbon concentrations. Added phosphate and nitrate were rapidly removed by phytoplankton, so that concentrations in the lake remained low. Almost all of the added nutrient was retained by the lake, in spite of relatively fast water renewal times. An average of 80% of the phosphorus income of the lake was sedimented. There was no return of phosphorus from sediments in spite of anoxic conditions in the hypolimnion. Photosynthesizing plankton reduced dissolved inorganic carbon concentrations severely, causing a flux of atmospheric CO_2 into the lake. From 69 to 95% of the inorganic + particulate carbon supplied to the lake was from the atmosphere. Results demonstrate that low carbon concentrations do not hinder eutrophication if phosphorus and nitrogen supplies are adequate. (Authors)

17040. Ustyugov, A. F. (Krasnoyarsk Dept., Siberian Fisheries Res. Inst., (SibNIIRKh), USSR). 1972. THE ECOLOGICAL AND MORPHOLOGICAL CHARACTERISTICS OF THE SIBERIAN CISCO [Coregonus albula sardinella (Valenciennes)] FROM THE YENISEY BASIN. J. Ichthyol., 12(5): 745-759.

The results of research into the ecological and morphological characteristics of two forms of the Siberian cisco [Coregonus albula sardinella (Val.)], in the Yenisey Basin, are presented. The qualitative ecological difference of the two forms is established on the basis of differences in their abundance, in their feeding and overwintering grounds in Yenisey Bay, in the time of the spawning migration in the Yenisey, the length of the migration route, spawning periods, spawning substrates, and differences in salinity and water temperature during the feeding period. The significance of the morphological differences of the two forms of the cisco is established for 26 characters.

17041. Marvin, Daniel E., Jr., and Dennis T. Burton (Dept. of Biol., Virginia Polytech. Inst. and State Univ., Blacksburg, Virginia). 1973. CARDIAC AND RESPIRATORY RESPONSES OF RAINBOW TROUT, BLUEGILLS AND BROWN BULLHEAD CATFISH DURING RAPID HYPOXIA AND RECOVERY UNDER NORMOXIC CONDITIONS. Comp. Biochem. Physiol., 46(4A): 755-765.

Heart rate, ventilation rate and routine oxygen consumption were measured in Salmo gairdneri, Lepomis macrochirus and Ictalurus nebulosus during rapid hypoxic stress and recovery under normoxic conditions. Cardiac and respiratory responses during hypoxia were similar to those reported in the literature for teleost fish. Immediate increases in heart rate and ventilation rate occurred in all three species after stress. When the mean heart rate for each species at 1 hr post-stress was compared with its pre-stress rate, differences in recovery patterns were found in all species. During recovery from hypoxia, rapid increases in oxygen consumption above pre-stress levels occurred in S. gairdneri and L. macrochirus. No significant differences between pre-stress and post-stress values were found in I. nebulosus. (Authors)

17042. Walters, Carl J., and Robert E. Vincent (Colo. Coop. Fish. Unit., Colo. State Univ., Fort Collins, Colorado 80521). 1973. POTENTIAL PRODUCTIVITY OF AN ALPINE LAKE AS INDICATED BY REMOVAL AND REINTRODUCTION OF FISH. Trans. Amer. Fish. Soc., 102(4): 675-697.

Invertebrate population changes were traced during 1966-1968 in Emmaline Lake, Colorado, after removal in 1964 of a population of stunted brook trout. Species composition of the zooplankton changed greatly after fish removal; in the absence of fish predation, large species were dominant. Populations of mud dwelling midges increased after fish removal; in the absence of fish predation, population regulation appeared to occur through density-dependent larval mortality. Insect emergence over rocky areas was highest in the second summer after fish removal, following increases in periphyton production. In 1968, the lake was restocked with yearling cutthroat trout that fed primarily on midge pupae and Daphnia middendorffiana, and doubled in weight during the first summer in the lake. Growth efficiency of the trout was estimated to be 10-30%. Less than half of the daily ration was present in trout stomachs at any time, as judged from observed growth rate and potential growth efficiency. A computer simulation model of the fish production system suggested that yield and optimum management policy (stocking rate and harvest rate) are most strongly affected by the quantities of terrestrial insects available to fish. Optimum stocking rate is apparently much lower than that which would maximize total invertebrate yield to fish. (Authors)

17043. Walter, Carl M., Fred C. June, and Harold G. Brown (Environ. Protection Agency, Region VII, Kansas City, Missouri). 1973. MERCURY IN FISH, SEDIMENTS, AND WATER IN LAKE OAHE, SOUTH DAKOTA. J. Wat. Poll. Contr. Fed., 45(10): 2203-2210.

Analyses for total mercury content were made of fish, sediment, and water samples collected in several locations in Lake Oahe, South Dakota, and its tailwaters. Mercury concentrations equal to or exceeding 0.5 mg/kg occurred in 30 of 225 fish samples tested (13 percent). Higher concentrations were found most frequently in predatory game fishes, primarily northern pike and walleye, from the Cheyenne River arm. Sediment samples with mercury concentrations above 0.5 mg/kg were found only in the Cheyenne River arm, but water samples contained only negligible amounts of mercury. Recommendations for further studies are presented. (Authors)

17044. Smith, R. J. F. (Biol. Dept., Univ. of Saskatchewan, Saskatoon, Saskatchewan, Canada). 1973. TESTOSTERONE ELIMINATES ALARM SUBSTANCE IN MALE FATHEAD MINNOWS. Canad. J. Zool., 51(8): 875-876.

Male fathead minnows lose the cells which contain alarm substance at the onset of spring breeding season and regain them in the fall. This allows the males to clean a spawning site, by rubbing against it, without releasing alarm substance that would frighten away interested females. (Auth.)

17045. Allen, John L., and Joe B. Sills (Fish Control Labs, La Crosse, Wisconsin). 1973. PREPARATION AND PROPERTIES OF QUINALDINE SULFATE, AN IMPROVED FISH ANESTHETIC. U.S. Dept. of the Interior, Investigations in Fish Control No. 47, 6 p.

The preparation of quinaldine sulfate ($QdSO_4$) from practical grade quinaldine and sulfuric acid yields a crystalline product which is water soluble and easily purified by recrystallization. The product conforms with the empirical formula $C_{10}H_{11}NSO_4$ and assays 99.4 percent pure by titration. The crystalline material has little odor and is water soluble; thus, it is less objectionable and much easier to handle than quinaldine for anesthetizing fish. (Authors)

17046. Schneider, James C. 1973. INFLUENCE OF DIET AND TEMPERATURE ON FOOD CONSUMPTION AND GROWTH BY YELLOW PERCH, WITH SUPPLEMENTAL OBSERVATIONS ON THE BLUEGILL. Michigan Dept. of Natural Resources Fisheries Research Report No. 1802, 25 p.

A series of 16 experiments were performed in aquaria on the feeding habits and growth of juvenile yellow perch in relation to size of ration (no food, to excess food), type of food (fish, mayfly nymphs, redworms) and temperature (11.0 to 27.8 C). Two additional experiments were conducted with juvenile bluegills. Growth was regressed against ration to determine the amount of food required for maintenance of body tissues (growth = 0). I found that maintenance ration, appetite and growth of perch varied with temperature, being somewhat optimal at about 23 C. At this temperature, perch ate more food and grew more rapidly than did bluegills. However, perch required a fish meal of 2.0% of their body weight per day for maintenance, whereas the bluegill needed only 1.3%. Perch grew best on a diet of fish and poorest on a diet of redworms. (Auth.)

17047. Northcote, T. G. 1972. SOME EFFECTS OF MYSID INTRODUCTION AND NUTRIENT ENRICHMENT ON A LARGE OLIGOTROPHIC LAKE AND ITS SALMONIDS. Verhandlungen Internationale Vereinigung Limnologie, 18(2): 1096-1106; Eutrophication, Univ. of Wisconsin, Madison, Wis. 53706, abstract 4977.

Shortly after experimental introduction of mysids into Kootenay Lake, British Columbia, the lake was subjected to heavy nutrient enrichment, predominately phosphates. The impacts of these events on the lake's limnology and the salmonid population are evaluated.

17048. European Inland Fisheries Advisory Commission (Working Party on Water Quality Criteria for European Freshwater Fish, FAO, Rome, Italy). 1964. WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH. REPORT ON FINELY DIVIDED SOLIDS AND INLAND FISHERIES. EIFAC Tech. Paper No. 1, 21 p.

First of a series of reports on water quality criteria for European freshwater fish prepared for and approved by the European Inland Fisheries Advisory Commission. The background of the project is described and reasons for establishing water quality criteria for fish explained. This is followed by a literature survey of: the direct effects of solids in suspension on death or survival of fish, their growth, and resistance to disease; suspended solids and reproduction; effects on behaviour; effect on food supply; total effect of suspended solids on freshwater fisheries. Tentative water quality criteria are suggested.

17049. Platts, William S. (USDA, Forest Service, 1075 Park Blvd. Boise, Idaho 83706). 1972. SEDIMENT IN A SALMON-STEELHEAD ENVIRONMENT. USDA-Forest Service, Intermountain Region, 106 pp.

The South Fork Salmon River aquatic environment steadily degraded from 1952 to 1965, due to accelerated sediment from logging and road construction. During this period the river was incapable of discharging the accrued bedload sediment as fast as it was being recruited. Logging and road construction were almost completely eliminated after 1965. From 1966 to 1972, the river eliminated much of its fine sediment and moved toward natural conditions due to stress being relieved from the watershed. Fine sediment increased in the spawning areas from 1952 to 1966 until fine sediment made up 50 percent of the spawning substrate. From 1968 to 1972, contained fine sediment in the river channel decreased at a steady rate

of 4.2 percent annually. The linear equation was fine substrate percent = 47.99 - 4.22 t. The complete river system followed this move towards equilibrium. Statistical analysis is presented to interpret the different substrate changes under both spatial and temporal conditions. It is predicted that the river should return to near-natural condition within the next decade, providing there is no additional land disturbance and no unusual large storms. (Auth.)

17050. Fisher, Frank. 1973. OBSERVATIONS ON THE SPAWNING OF THE MISSISSIPPI SILVERSIDES, Menidia audens, Hay. Calif. Fish and Game, 59(4): 315-316.

The spawning behavior is described as observed in Lexington Reservoir, Santa Clara County, California on May 11, 1973. This fish was introduced into California in 1967, originally in Clear Lake. (Auth.)

17051. Heath, Alan G., and G. M. Hughes (Res. Unit for Comp. An. Resp., Univ. of Bristol, Bristol, England). 1973. CARDIOVASCULAR AND RESPIRATORY CHANGES DURING HEAT STRESS IN RAINBOW TROUT (Salmo gairdneri). J. Exp. Biol., 59(2): 323-338.

Trout were subjected to a steady increase in water temperature (1.5° C/h) from 15°C until death occurred, while several respiratory and cardiovascular parameters were monitored. Oxygen consumption increased during the warming (Q_{10} = 2.35 between 16 and 20°C). At the higher temperatures the increase was more marked (Q_{10} = 4.96 between 20 and 26°C). Ventilatory frequency increased during the rising temperature with a general levelling off observed above 23°C. The amplitude of the pressure changes in the buccal and opercular cavities increased more than did the ventilatory frequency. Further analysis of the differential pressure across the gills suggests that the adjustment of respiratory pumping to the increased oxygen demand is predominantly in the volume pumped per stroke (cycle). Heart rate rose steadily with the increasing temperature until about 24-25°C, when a bradycardia usually became evident. Synchrony between the heart beat and the respiratory pumps was observed in some preparations at the higher temperatures. Blood pressure increases during the warming were more marked in the ventral aorta than in the dorsal aorta. At the highest temperatures, abnormal cardiac cycles were frequently observed. Arterial oxygen content declined slightly during warming and venous exygen content dropped to zero above 23°C. It is suggested that cardiovascular adjustments may be a limiting factor in this type of stress. (Authors' summ.)

17052. Avery, Eddie L. 1973. AN EXPERIMENTAL INTRODUCTION OF COHO SALMON INTO A LANDLOCKED LAKE IN NORTHERN WISCONSIN. Dept. of Natural Resources, Madison, Wis. Tech. Bulletin No. 69, 8 p.

An attempt was made to establish a coho salmon (Oncorhynchus kisutch) fishery in Pallette Lake, a 169-acre, oligotrophic lake in north central Wisconsin. Age 0 coho stocked in October 1968 grew only 5.4 inches in length and 116 grams in weight during three years in the lake. Age I coho stocked in April 1969 grew only 4.2 inches and 91 grams in 2-1/2 years. Growth of Age I coho stocked in October 1970 could not be determined because none were captured by electrofishing or in fyke nets and because angler harvest was selective for fish over 10.0 inches. Few coho from either the 1968 or 1969 stocks ever attained the minimum legal size of 10.0 inches. Though a few coho lived until their fourth fall in Pallette Lake, survival during their first two years was poor. Angler harvest of coho from the October 1968 stock and the October 1970 stock accounted for 0.04 percent and 9.0 percent, respectively, of the numbers stocked and 0.4 percent and 1.9 percent, respectively, of the pounds stocked. Anglers failed to capture any coho from the April 1969 stock. Planktonic Crustacea (especially Daphnia) in Pallette Lake were overgrazed by resident fishes. Coho salmon did not prey upon forage fishes such as the common shiner (Notropis cornutus), white sucker (Catostomus commersoni), cisco (Coregonus artedii) or yellow perch (Perca flavescens), but fed primarily upon terrestrial and aquatic insects. An inadequate food supply of insects and planktonic crustaceans stymied the growth of coho, prevented their eventual conversion to a piscivorous diet and was the primary reason for their failure in the

lake. Results of other attempts to create coho fisheries in the U. S. and Canada are discussed. In general, such stockings in inland waters have not been successful except in the Great Lakes. Any further attempt to create a salmonid fishery in Pallette Lake should consider chemical eradication of all fish, followed by a waiting period to allow insect and zooplankton populations to build up, then introduction of the selected salmonid species. (Auth.)

17053. Falk, M. R., D. V. Gillman, and L. W. Dahlke (Lake Mgmt. Section, Dept. of the Environ., Central Region, Winnipeg, Manitoba R3C 1G1, Canada). 1973. THE 1972 SPORTS FISHERIES OF GREAT BEAR AND GREAT SLAVE LAKES, NORTHWEST TERRITORIES. Environment Canada, Resource Mgmt. Branch, Central Region Technical Report Series No. CEN/T-73-8, 100 p., illus.

Creel census and biological sampling programs were carried out on the lake trout (Salvelinus namaycush) and other species of Great Bear and Great Slave Lakes, Northwest Territories. 4,386 anglers were interviewed from 6 sports fishing lodges. Information on the number and species composition of the catch retained and released was obtained. An estimated 46,897 and 25,286 kg of lake trout were harvested on Great Bear and Great Slave Lakes, respectively. 3,212 lake trout were sampled for length, weight, sex and maturity. Otoliths were removed and aged at later dates. Ages ranged from 5 to 42 years, lengths from 360 to 1,020 mm, and weight from 450 to 14,400 g. On Great Bear Lake trout first exhibited sexual maturity at age 13 (519 mm; 1,538 g) and were all sexually mature at age 22. Trout from Great Slave Lake, however, first attained sexual maturity at age 8 (490 mm; 1,253 g) and were fully mature at age 19. Sex ratio on each lake varied little from a 1:1 relationship. Growth rates differed among individual lodge samples and between Great Bear and Great Slave Lakes. All growth rates were similar until approximately 400 mm and age 6. After this age Great Slave trout exhibited larger gains in weight for a corresponding increase in length. Great Slave trout averaged 1,500 g heavier and 10 mm longer than Great Bear trout for corresponding ages beyond 6 years of age. Growth rates of trout were found to be much slower than those found in southern lakes. Comparisons were also made to other lake trout populations to determine the possible effect of the present exploitation rate. The present harvest of lake trout as trophies, fillet and angler lunches is substantial. Trout used for filleting comprised over 65 percent of the total catch. The data collected and local information sources indicate that the overall size and availability of trophy lake trout is declining due to the nature and magnitude of the present fishing harvest. In addition, all mature fish are susceptible to sports angling on the lake and the harvest is indiscriminate as to size and age. This raises a threat to the entire population because of the poor reproductive capacity and late maturation age of the stocks. The economic and conservation demands of the resource base to provide a sustained yield of lake trout can be best met by the continuance of the fishery on a trophy basis only. To ensure this, recommendations to convert the harvest primarily to trophy fish are made. Regulation changes are recommended to lower the catch and possession limits and to reduce mortality among released fish by implementing barbless hooks. Recommendations are also made to expand the creel census and sampling programs to portions of the fishery not covered and to investigate the effect of hooking mortality. (Authors)

17054. Dunson, William A., and Donald R. Martin (Dept. of Biol., Pennsylvania State Univ., University Park, Pa.). 1973. SURVIVAL OF BROOK TROUT IN A BOG-DERIVED ACIDITY GRADIENT., Ecology, 54(6): 1370-1376.

The acidity in Bear Meadows Bog water (pH 3.7-4.7) is not due to carbonic acid or to any other volatile acid. The approximate pK of the unknown bog water acid(s) is 6.0-6.5. Fish do not occur in Bear Meadows Bog or in Sinking Creek over a 4.8-km section below the bog where water pH is too low for their survival. The lowest pH in which brook trout and white suckers were caught in Sinking Creek was 4.25 at area 5 (5.25 km below the bog) after a period of unusually heavy rainfall. At a different time brook trout alone were caught at area 4, 5.2 km below the bog, when the pH was 4.75. The lowest recorded pH at this site was 4.0. Survival times of hatchery brook trout placed in boxes in Sinking Creek were directly related to pH. Individual differences in tolerance to low pH were quite marked. (Authors)

17055. Henderson, C., A. Inglis, and W. L. Johnson (Div. of Fishery Research, Bur. Sport Fish. & Wildlife, Washington, D. C.). 1972. MERCURY RESIDUES IN FISH, 1969-1970 - NATIONAL PESTICIDE MONITORING PROGRAM. Pesticides Monitoring Journal, 6(3): 144-159; Selected Water Resources Abstracts, 6(21): p. 54.

As part of the fish monitoring program conducted by the Bureau of Sport Fisheries and Wildlife since 1967, composite fish samples collected during the fall of 1969 and 1970 were analyzed for mercury. Fish were collected using seives, gill nets, traps, hook and line, and electrofishing. Three composite samples, each of a different species and consisting of 3-5 adult fish, were collected at each of 50 monitoring stations in 1969; similarly, three composite samples and in most cases a replicate sample of one of the species were collected at each of 100 stations in 1970. Stations were located on major rivers and lakes throughout the United States. Samples were wrapped in foil, frozen, and shipped to a laboratory for analysis by atomic absorption. Each composite was thawed, cut in small pieces, homogenized in a food chopper, digested, and analyzed by the cold vapor technique. Total mercury residues equal to or exceeding the sensitivity level of 0.05 ppm were found in 129 of the 145 samples in 1969 and 373 of the 393 samples in 1970. Values ranged from less than 0.05 to 1.25 ppm in 1969 samples and from less than 0.05 to 1.80 ppm in 1970 samples. Analyses by two different laboratories of 40 selected samples from the 1970 collection gave comparable results. Analyses of 24 selected 1970 samples indicated that 90 percent or more of the mercury in fish was in the form of methyl mercury.

17056. Chiszar, David, and John T. Windell (Dept. of Biol., Univ. of Colorado, Boulder, Colorado). 1973. PREDATION BY BLUEGILL SUNFISH (Lepomis macrochirus Rafinesque) UPON MEALWORM LARVAE (Tenebrio molitor). Animal Behaviour, 21(3): 536-543.

Eleven responses comprise behaviour of bluegill sunfish (Lepomis macrochirus Rafinesque) preying upon mealworm larvae of Tenebrio molitor. Since each response could be repeated during an attack, behaviour can become quite complex in terms of total number of components comprising a predatory chain. When sunfish attacked the first prey of feeding sessions, predatory sequences contained an average of 8.0 components. Sequences dealing with the second and with all subsequent prey averaged 9.5 and 12.4 components respectively. Increased sequence complexity with increasing satiety depended upon increases in the frequencies of orienting and approaching prey as well as stopping and turning away from prey. Accordingly, satiety is hypothesized to produce more selective responsiveness to prey rather than simple diminution of feeding behaviour. (Authors)

17057. Stainton, Michael P. (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg, Manitoba R3T 2N6, Canada). 1973. A SYRINGE GAS-STRIPPING PROCEDURE FOR GAS-CHROMATOGRAPHIC DETERMINATION OF DISSOLVED INORGANIC AND ORGANIC CARBON IN FRESH WATER AND CARBONATES IN SEDIMENTS. J. Fish. Res. Bd. Canada, 30(10): 1441-1445.

A simple, rapid method for determining dissolved inorganic carbon in water is described. A 20-cm^3 sample of water is drawn into a 50-cm^3 polypropylene syringe and acidified by injection of 1 cm^3 of dilute sulphuric acid. Twenty-nine cubic centimeters of helium at atmospheric pressure is injected into the syringe followed by 10 sec of manual agitation to partition CO_2 between gas and liquid phase. The gas phase containing 60% of CO_2 from the sample is then analyzed by gas chromatography. This method has been used to determine dissolved inorganic and organic carbon in Canadian Shield waters and to determine total carbonates in sediments. (Auth.)

17058. Kimura, Norihiko (Gunma Prefectural Fish. Exp. Sta., Shikishima-Cho, Maebashi, Japan). 1973. FINE STRUCTURE OF PEAR-SHAPED CELLS AND "VESICLE-RICH CELLS" IN PYLORIC CAECA OF RAINBOW TROUT. Jap. J. Ichthyol., 20(2): 94-106. In Japanese with English abstract and figures.

17059. Schneider, James C. 1973. RATE OF FOOD DIGESTION BY YELLOW PERCH (Perca flavescens) IN RELATION TO SIZE OF PERCH, SIZE AND TYPE OF FOOD, AND TEMPERATURE. Mich. Dept. of Natural Resources Fisheries Research Report No. 1803, 20 p.

Laboratory experiments were performed on the rate of food digestion by yellow perch. Perch were fed single food items of known size, and then sacrificed periodically to determine the amount of food remaining in their stomachs. In an initial experiment, the digestion rate of food which had been inserted forcibly into the esophagus was compared to the digestion rate of food which had been eaten voluntarily. In other experiments, I varied the temperature (7.8, 14.4, 22.2, and 27.2 C), size of perch (9.7, 28.2, 49.1, and 105.8 g), size of food item (0.09 and 1.9% of the weight of the perch), and type of food (fathead minnows and crayfish). I found that: (1) digestion rate of force-fed food was similar, on the average, to that of food eaten voluntarily; (2) time required for complete evacuation of the stomach was linearily related to temperature on a log-log scale; (3) large perch digested more grams of food per hour than did small perch. However, the amount of time required for evacuation of a meal of the same relative size--2.1% of the weight of the perch--was independent of perch size; (4) a small food item was digested at a slower rate, but in less time, than a large food item; and (5) crayfish were evacuated more slowly than were fish. The yellow perch digested food more rapidly than did the European perch or other species of fish as reported in the literature. (Auth.)

17060. Utter, Fred M., Fred W. Allendorf, and Harold O. Hodgins (Wash. Coop. Fish. Unit, Univ. of Wash., Seattle, Washington). 1973. RELATIONSHIPS IN PACIFIC SALMON AND RELATED TROUT BASED ON PROTEIN VARIATIONS. Systematic Zoology, 22(3): 257-270.

An investigation was made of the biochemical genetic variation within and among Pacific salmon (Oncorhynchus spp.) and related trout (Salmo spp.). Estimates (based on 19 to 23 loci) of proportion of loci polymorphic and average heterozygosity respectively were: pink salmon (O. gorbuscha) - .111 and 0.14, chum salmon (O. keta) - .100 and .006, sockeye salmon (O. nerka) - .087 and .018, coho salmon (O. kisutch) - .130 and .018, chinook (O. tshawytscha) - .130 and .015, and rainbow trout (S. gairdneri) - .261 and .037. The differences of these two parameters between populations of salmon and rainbow trout were significant and may reflect the greater habitat diversity of rainbow trout contrasted with Pacific salmon species. Interspecies comparisons were made among the above species plus masu salmon (O. masou) and cutthroat trout (S. clarkii), based on allelic proteins of eight loci and more complex protein patterns assumed to reflect four additional loci. A dendrogram, constructed from indices of similarity which reflected pairwise interspecies protein differences, separated the species into two major groups: one group contained the two trout species which were paired closely and - more distantly - the masu salmon, while the other group contained the remaining five species of salmon. In the latter group the chinook and coho salmon were paired together as were the pink and sockeye salmon; the chum salmon was intermediate between the two subgroups. (Authors)

17061. Lande, A. (Dept. of Limnol., Oslo Univ., Oslo, Norway). 1972. THE EXTINCTION OF FISH AND ACID WATER. Fauna (Oslo), 25(2): 105-110, illus, English summary; Selected Water Resources Abstracts, 6(22): p. 47.

During the later decades, and especially during the period 1960-65, the trout has become extinct in many lakes and rivers in southern Norway. The increased acidity of precipitation is certainly the main cause. The situation in Bygland, about 100 km north of Kristiansand is described. Some water samples were taken from different lakes and rivers in this area in Oct. 1970 and Oct. 1971. Analyses of pH, conductivity and ionic composition were carried out. The water is very poor in electrolytes, and very often it is the low pH, and not Ca or total ionic concentration that determines the conductivity. It seems that bog lakes, or seepage lakes have less variation in pH than lakes with large amounts of water flowing through, and in such seepage lakes the trout populations can survive.

17062. Vladykov, Vadim D. (Dept. of Biol., Univ. of Ottawa, Ottawa, Canada). 1973. NORTH AMERICAN NONPARASITIC LAMPREYS OF THE FAMILY PETROMYZONIDAE MUST BE PROTECTED. Canad. Fld Nat., 87(3): 235-239.

There are nine nonparasitic species of lampreys in five of the six North American genera. This paper gives ecological, economic, and ethical reasons why it is important that the nonparasitic lampreys must be conserved, and recommends urgent protection for the habitats of endangered species of the genus Lampetra, especially in California and Maryland. (Auth.)

17063. Hathaway, Ronald P., and John C. Herlevich (Dept. of Biol., Colo. College, Colorado Springs, Colorado). 1973. Gyrodactylus stableri sp. n., WITH NEW HOST AND LOCALITY RECORDS FOR SPECIES OF Gyrodactylus. J. Parasit., 59(5): 801-802.

Gyrodactylus stableri sp. n. is described from Fundulus kansae Gorman, from an irrigation ditch 9 miles south of Fountain (El Paso Co.), Colorado. Gyrodactylus spathulatus Mueller 1936, and G. wardi Kritsky and Mizelle 1968, are recorded from Catostomus catostomus, and G. colemanensis Mizelle and Kritsky 1967, is recorded from Salvelinus fontinalis. Host specimens for the latter 3 trematodes were collected from Trout Creek immediately below Lake Manitou, Teller Co., Colorado. (Authors)

17064. Solem, John O. (Royal Norwegian Soc. of Sciences and Letters, The Museum, Trondheim, Norway). 1973. DIEL RHYTHM OF FRY AND YOUNG OF Lota lota (PISCES). Oikos, 24(2): 325-327.

Field investigations on the diel rhythm of fry and young of Lota lota L. are presented. The investigations were carried out in a lake just outside Trondheim, Norway (63°14' N, 10°26' E). In June and early July, and probably also in May, the fry/young were desynchronized, while they were synchronized for night activity in late July and August. The synchronization for nocturnal activity pattern occurred when the light intensity at night fell to 5-10 lux, and when the young Lota lota were leaving the study area. (Auth.)

17065. Sawyer, Roy T., and Donald L. Hammond (Dept. of Biol., College of Charleston, Charleston, South Carolina). 1973. OBSERVATIONS ON THE MARINE LEECH Calliobdella carolinensis (HIRUDINEA: PISCICOLIDAE), EPIZOOTIC ON THE ATLANTIC MENHADEN. Biol. Bull., 145(2): 373-388.

In January through March, 1971, and to a less extent the same period in 1972 and 1973, the marine leech, Calliobdella carolinensis Sawyer and Chamberlain 1972, was epizootic on the Atlantic menhaden, Brevoortia tyrannus, in the estuaries of South Carolina. Prior to this epizootic outbreak (epidemic) the leech was practically unknown. The population dynamics of this outbreak were studied near Charleston, South Carolina, for three years, primarily in an estuarine creek and in the surf zone of an exposed beach. Calliobdella carolinensis displays a seasonal occurrence which correlates with the temperature of the water. The leeches reach their greatest abundance in late February and early March, when the water is coldest (9 to 10°C). At that time the leeches breed and deposit at least 20 helmet-shaped cocoons. No leeches are found from the end of April until the following mid-December. The leech occurs primarily in the estuaries of South Carolina, and is reported also from Virginia. It is not known south of South Carolina. Feeding, reproductive behavior, growth, life cycle, salinity tolerance and other aspects of the biology of C. carolinensis are described. (Authors' summ.)

17066. Holway, Jamieson E., and Charlie E. Smith (U. S. Fish & Wildl. Service, Bur. Sport Fish. & Wildl., Fish Cult. Center, Bozeman, Montana). 1973. INFECTIOUS HEMATOPOIETIC NECROSIS OF RAINBOW TROUT IN MONTANA: A CASE REPORT. Journal of Wildlife Diseases, 9(4): 287-290.

Infectious hematopoietic necrosis was diagnosed in rainbow fingerlings (Salmo gairdneri kamloops) during an epizootic at a hatchery in Montana. Microscopic pathology and effects of the causative virus in cell culture are described. (Authors)

17067. Wakabayashi, Hisatsugu, and Syuzo Egusa (Dept. of Fish., Univ. of Tokyo, Tokyo, Japan). 1973. Edwardsiella tarda (Paracolobactrum anguillimortiferum) ASSOCIATED WITH POND-CULTURED EEL DISEASE. Bull. Jap. Soc. Sci. Fish., 39(9): 931-936. In English.

Morphological and biochemical characteristics of 22 strains of an enteric bacterium isolated from diseased pond-cultured eels in Shizuoka Prefecture in 1972 were examined. These organisms were gram-negative, peritrichously flagellated rods. They gave negative oxidase reaction, utilized glucose fermentatively in Hugh-Leifson's medium and reduced nitrate to nitrite. Some distinguishing features of the organisms were the production of hydrogen sulfide and indol, positive to methylated test, negative to Voges-Proskauer test, no growth on Simmon's citrate agar, growth on Christensen's citrate agar, decarboxilization of lysine and ornithine, and utilization of fructose, galactose, mannose, maltose, and glycerol. All of the strains examined were sensitive to dihydrostreptomycin and kanamycin, but some of them were resistant to chloramphenicol, tetracycline and colistin. The above properties suggest that the organism should be identified as Edwardsiella tarda, with which Paracolobactrum anguillimortiferum is thought to be synonymous. (Authors)

17068. Moodie, G. E. E., J. D. McPhail, and D. W. Hagen (College of Fish., Univ. of Washington, Seattle, Washington). 1973. EXPERIMENTAL DEMONSTRATION OF SELECTIVE PREDATION ON Gasterosteus aculeatus. Behaviour, 47(1-2): 95-105.

Three groups of independently conducted tests demonstrate selective predation on sticklebacks having various plate numbers. Differential survival of sticklebacks in some tests was clearly due to behavioural differences. Since fish from two populations were used, however, we are unable to say whether this indicates differential predation upon plate classes, or differences between populations, or both. Fish with seven plates seemed to be at a selective advantage only under winter conditions in the laboratory, and these results conflict with those from the field where sevens are at an advantage during the summer. This may result from behavioural changes associated with breeding during the summer. Results of test conducted under winter conditions are in accord with selective predation observed in three natural populations. Given the different feeding behaviour of the predators it seems likely that the traits contributing to survival are general ones that function in a variety of physical and biotic environments. (Authors' summ.)

17069. Schreck, Carl B. (Colo. Coop. Fish. Unit, Colorado State Univ., Fort Collins, Colorado). 1973. UPTAKE OF ^{3}H-TESTOSTERONE AND INFLUENCE OF AN ANTIANDROGEN IN TISSUES OF RAINBOW TROUT (Salmo gairdneri). General & Comparative Endocrinology, 21(1): 60-68.

^{3}H-Testosterone was administered to yearling rainbow trout (Salmo gairdneri) of both sexes to establish accumulation and retention of androgen by various organs and tissues. Radioactivity in plasma, liver, and gonad were determined six times during the 24 hours post treatment. Radionuclide uptake in plasma was rapid, while the retention time in the liver was several times that of the blood, and no sexual dimorphism was found. The testes accumulated significantly more radionuclide than did ovaries; the former retained the radionuclide longer than any other tissue. Pretreatment of trout with the potent antiandrogen cyproterone acetate significantly reduced radioactivity in plasma of both sexes, in testes but not ovaries, and possibly in the liver of the male. No effect due to the androgen antagonist was apparent in kidney, spleen, gall bladder, brain, pituitary, or epaxial muscle. High levels of radioactivity found in the bile indicates that the trout were using a hepatic route for clearance of the exogenous steroid. (Auth.)

17070. Snelson, Franklin F., Jr., and Robert E. Jenkins (Dept. of Biol. Sci., Florida Tech. Univ., Orlando, Florida). 1973. Notropis perpallidus, A CYPRINID FISH FROM SOUTH-CENTRAL UNITED STATES: DESCRIPTION, DISTRIBUTION AND LIFE HISTORY ASPECTS. The Southwestern Naturalist, 18(3): 291-304.

17071. Hansen, Douglas R. (Dept. of Game, Fish and Parks, 603 8th Ave., E., Webster, South Dakota 57274). 1973. STREAM CHANNELIZATION EFFECTS ON FISHES AND BOTTOM FAUNA IN THE LITTLE SIOUX RIVER, IOWA. N. C. Div. Amer. Fish. Soc. Spec. Pub. 2, pp. 29-51.

Differences in certain physical factors, bottom fauna, and fish populations were evaluated in channelized and unchannelized portions of the Little Sioux River, Iowa, during 1969-71. The Little Sioux River is a turbid, warmwater river located in western Iowa. Characteristic stream channels are meandering, non-uniform channels with heavy vegetative cover in the unchannelized section and straight channels with relatively uniform depth and no heavy vegetative cover in the channelized section. Early channelization (1905-1920) reduced the lower length of river from 63 to 38.5 miles, and channelization completed in 1962 further reduced the length by 4.5 miles, a total reduction of 54%. Daily fluctuations of water temperature in July were greater, maximum daily water temperatures averaged 1.3 C higher, and mean daily water temperatures 0.3 C higher, in the channelized section than those in the unchannelized section. Consistently higher turbidities were measured in the channelized section during low runoff, averaging 31.2% higher than those measured in the unchannelized section. Composition of bottom fauna was similar in the two sections. Colonization of macroinvertebrates on artificial substrates suggested a lack of suitable attachment areas in the channelized section, also indicated by higher numbers of drift organisms in the channelized section. Numbers of fish species were greater in the unchannelized section. Major changes in species composition of fishes compared to 1950 studies resulted from a control structure installed in 1963 near the mouth, blocking upstream movement of certain species from the Missouri River. Unbaited hoop nets caught more large channel catfish, the most important game species, in the unchannelized section. Hoop net catches and Primacord explosive samples collected greater numbers of smaller channel catfish (less than 254 mm) in the channelized section during late summer and early fall. Possible downstream movement from the unchannelized section, suggested by movement studies, and similar growth rates, prevented drastic differences in standing crops of fish between the two areas. (Auth.)

17072. Fee, Everett J. (Center for Great Lakes Studies, Univ. of Wisconsin-Milwaukee, Milwaukee, Wisconsin 53201). 1973. A NUMERICAL MODEL FOR DETERMINING INTEGRAL PRIMARY PRODUCTION AND ITS APPLICATION TO LAKE MICHIGAN. J. Fish. Res. Bd. Canada, 30(10): 1447-1468.

A computer-based model for determining production by phytoplankton, integrated over depth and over an arbitrary time interval, is described. The solution incorporates light inhibition and uses the actual distribution of surface irradiance for the time interval of interest, since it is not possible to predict the detailed nature of cloudiness. Statistical procedures for estimating the model parameters from experimental data relating the rate of carbon uptake to irradiance are described. The model is applied to data collected from May 27, 1970 through February 3, 1971 from Lake Michigan. Integral primary production was bimodal at inshore and offshore stations with minimum production in midsummer and winter. There was great daily variability of integral production, due solely to variation of light. From this it is inferred that occasional in situ measurements would give a very poor knowledge of true seasonal trends. The model output was verified by performing two in situ experiments. The agreement was better than 95% on both dates. The model makes it possible to estimate integral primary production on a routine basis in large water bodies with well-mixed photic zones. (Auth.)

17073. Shuster, W. S. (Bio-Environmental Engineering Div., Rensselaer Polytechnic Inst., Troy, New York). 1971. CONTROL OF POLLUTION FROM OUTBOARD ENGINE EXHAUST. A RECONNAISSANCE STUDY. Environ. Protection Agency, Water Pollution Control Res. Series, 15020 ENN, 38 p. Available at U.S. Government Printing Office, Washington, D. C. 20402 - 50 cents.

A study was made to determine extent of pollution resulting from operation of a two-cycle outboard engine. Comparisons were made of engine operation with and without a pollution control device attached. Biodegradability of the fuel and exhaust products were also studied. (Auth.)

17074. Maksimov, V. A. (Dept. of Ichthyol., Moscow State Univ., Moscow, USSR). 1972. SOME DATA ON THE ECOLOGY OF THE KAMCHATKA TROUT (Salmo mykiss Walbaum) FROM THE UTKHOLOK RIVER. J. Ichthyol., 12(5): 759-766.

A description is given of the spawning stock of the Kamchatka trout (Salmo mykiss Walb.) from the Utkholok River. Material is presented on scale structure, age, size-weight composition, the ratio of the sexes, fecundity and the ecology of the young. A connection is noted between the beginning of the Kamchatka trout's spawning run and the lowering of water level and temperature. Three groups of fish are distinguished by scale structure: typically diadromous, coastal, and river fish. A comparison with published data suggests that the Kamchatka trout is ecologically similar to the diadromous steelhead Salmo gairdneri Rich.

17075. Wagner, John F., and Michael Parker (Dept. of Zool. and Physiol., Univ. of Wyoming, Laramie, Wyoming 82070). 1973. PRIMARY PRODUCTION AND LIMITING NUTRIENTS IN A SMALL, SUBALPINE WYOMING LAKE. Trans. Amer. Fish. Soc., 102(4): 698-706.

Primary production and limiting nutrients were studied by ^{14}C techniques in a small, shallow, subalpine lake. There was no relationship between productivity at any depth and light intensity at that depth. Samples taken near the lake bottom always had higher productivity than samples taken near the surface, probably due to more optimal nutrient conditions. Nutrient enrichment experiments support this hypothesis, since sediment extract and ethylenediamine-tetraacetic acid were always effective in enhancing productivity. The effects of other nutrients and nutrient combinations were less consistent, and tended to change through the summer. A large number of significant three, four and five factor interactions in midsummer indicated that the nutrient requirements of the algal community were most complex at this time. Although retention time increased through the summer from 10 to 71 hours, productivity tended to more closely parallel water temperature. Studies of currents showed that the western end of the lake had relatively little horizontal water movement compared to that of the eastern end, and that the latter portion had retention times even less than average. Significantly lower productivity in the faster flushing portion of the lake suggests that algal populations in this area were unable to accumulate before being flushed downstream. Because of the lake's low average retention time, it would not be practical to artificially increase the primary productivity of the studied, or similar lakes; the rapid flushing would not allow added nutrients or increased algal populations to accumulate in the lake. (Authors)

17076. Moore, C. J., G. A. Stevens, A. J. McErlean, and H. H. Zion (Acad. of Nat. Sci., Philadelphia, Pennsylvania). 1973. A SPORT FISHING SURVEY IN THE VICINITY OF A STEAM ELECTRIC STATION ON THE PATUXENT ESTUARY, MARYLAND. Chesapeake Science, 14(3): 160-170.

An interview-count sport fishing survey was conducted from May 1971 through April 1972 within 10,340 acres of the Patuxent Estuary, from Jacks Bay to Holland Cliff, including the effluent canal of the Potomac Electric Power Company's steam electric station (SES) located at Chalk Point, Maryland. An estimated 41,238 angler trips, totaling 170,535 hours, were made within this area of the Patuxent Estuary during the period sampled. These anglers caught 383,900 fish, of which 176,900 were kept and 207,000 were returned to the water. The average angler spent 4.1 hours per trip and harvested 1.0 fish per hour or 4.0 fish per trip. White perch dominated the catch with 188,200 caught and 102,900 harvested. Of 69,500 striped bass caught, 66,000 were under the legal size limit of 12 inches and were returned to the water. Spot were taken throughout the estuary during June through October, with 19,500 being harvested. Small catches of spot continued to be reported only within the heated effluent canal during November, December, and March. Over 50 percent of all angler trips were made to the heated effluent canal of the Chalk Point SES, with over 90 percent of these trips being made during the cooler seasons from October through April when little or no fishing occurred within other areas of the estuary. An estimated 13,500 recreational crabbers

spent 59,200 hours and harvested 101,700 crabs from May through November 2. These crabbers averaged 1.7 crabs per hour and 7.5 crabs per trip. Results are compared to a similar sport fishing survey carried out within this area of the Patuxent Estuary prior to the operation of the SES. (Authors)

17077. Ruf, H., and H. Rohde (Inst. for Radiochemie, Kernforschungszentrum, Karlsruhe, West Germany). 1973. DETERMINATION OF MERCURY CONTENTS IN DIVERSE SAMPLES OF FISH AND OTHER BIOLOGICAL MATERIALS BY NEUTRON ACTIVATION ANALYSIS (Neutronenaktivierungsanalytische Bestimmungen von Quecksilbergehalten in Diversen Fischproben und anderen biologischen Materialien). Zeitschrift fur Analytische Chemie, 263(2): 116-120; Selected Water Resources Abstracts, 6(18): p. 37.

Mercury contents in diverse samples of fish and other biological materials have been determined by neutron activation analysis measuring the activity of Hg-197. A method described in the literature was used for the indispensable separation of the mercury activity utilizing the volatility of HgCl2 and the low electric potential of deposition of mercury metal. The separation of Au-198 usually found in the irradiated materials was accomplished by volatilisation of the mercury metal at 850 C. Seriously high contents of mercury were found in some samples of Japanese canned tuna and in whitefish of the Rhine River.

17078. Silbergeld, Ellen K. (Stroud Water Research Center, Dept. of Limnol., Acad. of Natural Sciences of Philadelphia, Avondale, Pennsylvania 19311). 1973. DIELDRIN. EFFECTS OF CHRONIC SUBLETHAL EXPOSURE ON ADAPTATION TO THERMAL STRESS IN FRESHWATER FISH. Environmental Science & Technology, 7(9): 846-849.

The freshwater fish, Etheostoma nigrum, were pretreated with 2.3 ppb dieldrin for 30 days and then exposed to thermal stress, applied by heating the water at a rate of 1°C/hr to a maximum of 7-9°C above ambient temperature. Pretreated fish had significantly higher mortality than fish not pretreated with dieldrin but also exposed to the same thermal stress. Measurements of blood glucose, feeding, growth, oxygen consumption, opercular movement, whole body lipid content, and liver condition were made throughout the experiment. Pretreated fish demonstrated significant changes in all of the above parameters except opercular movement during the first 15 days of exposure to dieldrin. After 15 days, pretreated fish were found to have adapted to dieldrin exposure, as indicated by significant reversals of the above changes (except for liver damage, which was not reversed but progressed over time). In the adapted state, the pretreated fish remained different from untreated fish, in terms of these parameters. These differences provide grounds for predicting differential response to sublethal thermal stress for the pretreated and untreated fish. Such response is discussed as it may relate to the effects of chronic sublethal exposure to dieldrin. (Auth.)

17079. Smith, G. R. (Mus. of Zool., Univ. of Michigan, Ann Arbor, Michigan). 1973. ANALYSIS OF SEVERAL HYBRID CYPRINID FISHES FROM WESTERN NORTH AMERICA. Copeia, No. 3, pp. 395-410.

Three hybrid combinations of western North American cyprinid fishes are identified by their intermediacy in osteological and morphometric characteristics. Acrocheilus alutaceus X Richardsonius balteatus is reported from Salmon Falls Creek, Nevada. Rhinichthys osculus X Richardsonius balteatus, Rhinichthys osculus X Rhinichthys cataractae, and Rhinichthys backcross progeny are described from one sympatric assemblage from Kimball Creek, Utah. Principal components analysis proves to be an effective way of describing relative similarity, including hybrid intermediacy. The method efficiently discriminates between hybrids and unusual variants that happen to be intermediate in several characters. (Auth.)

17080. Balakhnin, I. A., and N. P. Galagan. 1972. TRANSFERRIN TYPES IN Cyprinus carpio (L.). Hydrobiological Journal, 8(6): 82-84.

Transferrin types in various forms of Cyprinus carpio are compared.

17081. Marking, Leif L., and Verdel K. Dawson (Fish Control Labs., Bur. of Sport Fish. & Wildlife, La Crosse, Wisconsin). 1973. TOXICITY OF QUINALDINE SULFATE TO FISH. U. S. Dept. of Interior, Bur. of Sport Fish. & Wildl., Investigations in Fish Control No. 48, 8 p.

The acute toxicities of the candidate fish anesthetic, quinaldine sulfate ($QdSO_4$), were determined against selected species of coldwater and warmwater fishes. The LC50's (concentrations producing 50-percent mortality) were derived for 3-, 6-, 24-, and 96-hour exposures in bioassays with different temperatures, hardnesses, and pH's. The 96-hour LC50's of $QdSO_4$ ranged from 6.8 mg/l for largemouth bass to 72.5 mg/l for carp. In very soft water $QdSO_4$ solutions are acidic and considerably less toxic than in harder water. This lack of activity is attributed to a decrease in the pH of the test solution which thereby decreases the concentration of the active, un-ionized form of the molecule. (Authors)

17082. Haaker, Peter L. 1973. AMBICOLORATION IN SOME CALIFORNIA FLATFISHES. Calif. Fish and Game, 59(4): 299-304.

Five partially or extremely ambicolorate California flatfishes: the bigmouth sole, Hippoglossina stomata; Dover sole, Microstomus pacificus; curlfin sole, Pleuronichthys decurrens; horneyhead turbot, Pleuronichthys verticalis; and California tonguefish, Symphurus atricauda, are described. Possible causal factors of ambicoloration are discussed but no definite conclusions are reached. (Auth.)

17083. Banner, Arnold, and Joel A. Van Arman (Aquatic Sciences, Inc., Boca Raton, Florida). 1973. THERMAL EFFECTS ON EGGS, LARVAE AND JUVENILES OF BLUEGILL SUNFISH. Environ. Protection Agency Ecological Research Series Report EPA-R3-73-041, 111 p. Available from GPO Sup Doc as EP1.23:73-041, $2.10; microfiche from NTIS as PB-222 625, $1.45; Selected Water Resources Abstracts, 6(21): p. 69.

Bioassay experiments were conducted to determine thermal tolerance of early life history stages of bluegill sunfish. Bluegill eggs hatched at temperatures from 18 to 36C during two incubation tests. Maximal hatch occurred at 22.2 and 23.9C. Lower TL50 temperature for hatch of normal fry was 21.9C and upper TL50 temperature was 33.8C. Juvenile bluegills acclimated to 12.1C had a lower 96-hour TL50 of 3.2C and an upper 96-hour TL50 of 27.5C. Juveniles acclimated to 32.9C had a lower 96-hour TL50 of 15.3C and an upper 96-hr TL50 of 37.3C. TL50 increased with increasing temperature of acclimation. For juveniles acclimated to a given temperature, upper TL50 decreased with longer exposure. A preliminary test determined ranges of thermal tolerance for sac-fry and swim-up fry. In another preliminary test, juvenile bluegills were acclimated to 12.1, 19.0, 26.0 or 32.9C, and reared at a series of test temperatures for three to six wks to define optimal temperature ranges for growth and survival. Additional research determined conditions for the culture of Lepomis macrochirus, including spawning induction, hatching, and growth of larvae and juveniles.

17084. Platts, William S. (USDA, Forest Service, 1075 Park Blvd. Boise, Idaho). 1972. THE EFFECTS OF HEAVY METALS ON ANADROMOUS RUNS OF SALMON AND STEELHEAD IN THE PANTHER CREEK DRAINAGE, IDAHO. Western proc., Fifty-second Ann. Conf. of the Western Assn. of State Game and Fish Commissioners: pp. 582-597.

Panther Creek, a tributary of the Salmon River, once supported anadromous runs of salmon and steelhead trout plus resident game fish. Due to mine and mill pollution, the drainage lost these anadromous runs and much of its esthetic value. Heavy metals (copper and iron), in combination with decreased pH and increased sediment, persist in toxic or degrading levels at all times. The mine-mill area with copper content in tributary waters as high as 1,200,000 µg/l increased the copper content in Panther Creek over 30 times natural conditions. The high iron and sulphur input resulted in waters with low pH causing iron to precipitate on the stream channel and also provide energy source for iron bacteria following their domination of some stream sections. Solutions are given for correcting the pollution sources. (Auth.)

17085. Mathisen, Ole A. (Coll. of Fisheries, Washington Univ., Seattle, Washington). 1972. BIOGENIC ENRICHMENT OF SOCKEYE SALMON LAKES AND STOCK PRODUCTIVITY. Verhandlungen Internationale Vereinigung Limnologie, Vol. 18, Part 2, pp. 1089-1095; Eutrophication, Water Resources Information Program, Univ. of Wisconsin, Madison, Wisconsin, No. 37, abstract 5055.

It is demonstrated that diminution of the sockeye salmon runs in the Nushagak District, Alaska, is ascribable to several density-dependent factors: the escapement levels computed from existing historical records have been remarkably stable during the last 60 years of commercial fishing operations while yields are declining.

17086. Jackivicz, Thomas P., Jr., and Lawrence N. Kuzminski (Univ. of Massachusetts, Amherst, Massachusetts). 1973. A REVIEW OF OUTBOARD MOTOR EFFECTS ON THE AQUATIC ENVIRONMENT. J. Wat. Poll. Contr. Fed., 45(8): 1759-1770.

Various aspects of outboard motor operation, including the magnitude of watercraft usage, operation and efficiency of a two-cycle engine, composition of outboard motor fuels, and compounds emitted during operation are reviewed. Compounds emitted to receiving waters originate from drainage of crankcase liquids and from unburned fuel passing through the combustion chamber. Over half the original fuel mixture for outboard motors may be emitted unburned into receiving waters. Factors affecting the quantity of compounds exhausted from outboard motors include horsepower rating, crankcase size, composition of fuel mixture, tuning of the engine, and speed of operation. Some of the compounds measured in water contaminated by motor exhaust include volatile and nonvolatile oil, lead, and phenols. (Authors)

17087. U. S. Dept. of Commerce, (Washington, D. C. 20230). 1973. POWERPLANT COOLING SYSTEMS ENTRAIN SMALL FISH--WILL THE ESTUARINE ECOSYSTEM BE HARMED? U. S. Dept. of Commerce, Science and Engineering News from NOAA, SEN-42, 10 p.

Large numbers of small fish pass through the intake screens of many powerplant cooling systems and suffer acute thermal shock when they suddenly encounter warmer water. Effects may be even more pronounced when they return to the cooler water in which they were originally acclimated. If not killed outright, they may be stunned and unable to avoid predators. Powerplants may ecologically damage estuaries that are nurseries for larvae of many species of fish. Each powerplant site must be carefully examined because plant design and characteristics and fish species all vary.

17088. Gratzek, J. B., Trudy Scott, and J. Brown (Dept. of Med. Microbiol., College of Vet. Med., Univ. of Georgia, Athens, Georgia). 1973. ANTIVIRAL RESISTANCE INDUCED IN CHANNEL CATFISH BY POLYINOSINIC: POLYCYTIDYLIC ACID (POLY I:C). Paper presented at Conf. of Research Workers in Animal Diseases, Chicago, November 27.

Poly I:C was given to 1.7 gram channel catfish fingerlings by intraperitoneal injection and subsequently challenged by gill exposure to channel catfish herpesvirus in 28 C water for 30-60 minutes. When fish were injected with 5 mcg of poly I:C and challenged with virus 24 hours later, there were significantly fewer deaths in the treatment group ($P > .01$) as compared to virus exposed control fish. When fingerlings injected with 5 mcg of poly I:C were challenged with virus on day 0, 1, 2, 4, 6, 8, and 24, maximal protection was induced at 4 and 6 days. Numbers of challenged fish surviving at 8 days was lower ($P > .01$) than those challenged at 4 and 6 days. Fish inoculated with poly I:C 24 days prior to challenge were fully susceptible to virus challenge as compared to nontreated virus challenged controls ($P > .01$), however, fish which had been inoculated with poly I:C 24 days earlier and which had survived a previous virus challenge were highly ($P > .01$) resistant to a second challenge of virus. (Authors)

17089. Gesser, H., and O. Poupa (Dept. of Zoophysiol. and Dept. of Clin. Physiol., Univ. of Göteborg, Sweden). 1973. THE LACTATE DEHYDROGENASE SYSTEM IN THE HEART AND SKELETAL MUSCLE OF FISH: A COMPARATIVE STUDY. Comp. Biochem. and Physiol., 46(4B): 779-795.

17090. Massaro, Edward J. (Dept. of Biochem., State Univ. of New York at Buffalo, Buffalo, New York). 1973. TISSUE DISTRIBUTION AND PROPERTIES OF THE LACTATE AND SUPERNATANT MALATE DEHYDROGENASE ISOZYMES OF THE GRAYLING, Thymallus arcticus (Pallas). J. Exp. Zool., 186(2): 151-158.

By gel exclusion chromatography the molecular weight of T. arcticus LDH was estimated to be 135,000-140,000 and that of MDH to be 65,000-70,000. Employing electrophoretic mobility in starch gel, molecular hybridization, and immunoprecipitation, the LDH isozymes could be classified into three major groups designated a, b and c and a minor group designated β. The c group was found exclusively in the eye. All tissues examined contained a, b and c group isozymes. The interaction of skeletal muscle a-group isozymes with rabbit anti-weakfish (Cynoscion regalis) A_4 LDH antiserum was weak and, therefore, similar to that of the group of isozymes of Prosobium cylindraceum previously designated f (Massaro '72). Starch gel electrophoresis at pH 8.6 resolved three major isozymes of supernatant MDH. In skeletal muscle, two additional minor, weakly detectable isozymes were observed. These exhibited a greater net negative charge than the major isozymes and may be conformational isozymes. (Auth.)

17091. Schneider, James C. 1973. RESPONSE OF THE BLUEGILL POPULATION AND FISHERY OF MILL LAKE TO EXPLOITATION RATE AND MINIMUM SIZE LIMIT: A SIMULATION MODEL. Mich. Dept. of Nat. Res., Fisheries Research Report No. 1804, 18 p.

The effects of fishing on a typical, but slow-growing population of bluegills in Mill Lake were simulated. Hypothetical fisheries were generated by varying exploitation rate and age of entry. Corresponding changes in the catch and in the size and structure of the bluegill population were predicted. Certain combinations of exploitation rate and age of entry (forming the eumetric line) produced the highest sustained yield to the angler. The analysis also showed that minimum size limit should be increased--up to a maximum of 6.0 inches--as exploitation rate increases. Overexploitation, in terms of wasting potential yield or depleting the spawning stock, will not occur if size limits or fishing rates are managed so that the fishery is operating at or above the eumetric line. A bluegill fishery, typical of southern Michigan lakes (μ = 30%, size limit about 5.5 inches), produced a yield of about 7 kg (90 bluegills) per hectare. The numbers of bluegills larger than 5.0 and 7.0 inches which remained in the lake were 77% and 34%, respectively, of the highest number possible. (Auth.)

17092. Henegar, Dale L., and Keith W. Harmon (Game and Fish Dept., 2121 Lovett Ave., Bismark, North Dakota 58501). 1973. A REVIEW OF REFERENCES TO CHANNELIZATION AND ITS ENVIRONMENTAL IMPACT. N. C. Div. Amer. Fish. Soc., Spec. Pub. 2, pp. 79-83.

Available literature is briefly reviewed under the following headings: downstream flooding, drainage outlets, sediment damage, groundwater recharge, fishery losses, wildlife losses. A bibliography of 63 titles is presented. All of the papers in the bibliography are not reviewed. -- John L. Funk

17093. Gage, John, and P. B. Tett (Scottish Marine Biol. Assn., Dunstaffnage Marine Res. Lab., Oban, Scotland). 1973. THE USE OF LOG-NORMAL STATISTICS TO DESCRIBE THE BENTHOS OF LOCHS ETIVE AND CRERAN. J. Animal Ecology, 42(2): 373-382.

Log-normal distributions have been fitted successfully to species abundances in macrobenthic samples from seven stations in Loch Etive, Loch Creran and the Firth of Lorne, all near Oban on the west coast of Scotland. Sample estimates of log-normal parameters have been used as statistics to characterize the macrobenthic communities. Muddy-sand and soft-mud stations were distinguished on the basis of log-normal statistics. A significant trend in increasing values of the 'uneven-ness' component of diversity in soft mud stations towards the head of Loch Etive was demonstrated. Comparisons were made between these results and the results of the application of Sanders' rarefaction method to the same date. (Authors' summ.)

17094. Morrow, James E. (Dept. of Biol. Sci., Univ. of Alaska, Fairbanks, Alaska). 1973. OIL-INDUCED MORTALITIES IN JUVENILE COHO AND SOCKEYE SALMON. J. Mar. Res., 31(3): 135-143.

Advanced parr of coho salmon (Oncorhynchus kisutch) and sockeye salmon (O. nerka) were exposed in laboratory tanks to oil poured on the surface of artificial seawater in amounts ranging from 500 to 3500 ppm equivalent, at water temperatures of 3°, 8°, and 13°C. Statistically significant increases in the mortality rates over control animals were observed at all oil concentrations and at all temperatures. The mortality rates appeared to be directly related to oil concentration and inversely to temperature. Oil that had been exposed to air for 30 days did not produce mortality that was significantly greater than that of the control groups. Stress behavior under the influence of oil is described. (Auth.)

17095. European Inland Fisheries Advisory Commission (Working Party on Water Quality Criteria for European Freshwater Fish, FAO, Rome, Italy). 1968. WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH. REPORT ON EXTREME pH VALUES AND INLAND FISHERIES. EIFAC/T4, 18 p.

Second in a series of reports on water quality criteria for European freshwater fish prepared for the European Inland Fisheries Advisory Commission (EIFAC) by the Working Party on Water Quality Criteria. The background of the project is described and reasons for establishing water quality criteria for fish explained. This is followed by a literature survey on effects of acid pH and alkaline pH values. Tentative water quality criteria are suggested as well as the scope for further research.

17096. Blaxter, J. H. S. (Dunstaffnage Marine Res. Lab., Oban, Scotland). 1973. MONITORING THE VERTICAL MOVEMENTS AND LIGHT RESPONSES OF HERRING AND PLAICE LARVAE. J. Mar. Biol. Assn. U.K., 53(3): 635-647.

The movements of herring and plaice larvae of different age, from hatching to about 8 weeks old, were monitored at different levels in a vertical tube by means of matched pairs of thermistors controlled and 'balanced' by bridge circuits. Movement of larvae past the thermistors upset the balance and the resulting change in the circuit could be followed on a pen-recorder. Having established, by visual comparisons, the interpretation of the pen record, experiments could be performed over extended periods or at low light intensities when visual observations would have been tedious or impossible. The numbers of larvae present were shown by the number of spikes on the pen record per unit time, while a measure of their size or activity was given by the height of the spikes. The light intensity could be altered by interposing neutral-density filters between an artificial light source and the surface of the tube. Alternatively, natural daylight could be beamed in by a mirror above the tube when placed by a window. Using artificial light, changes of very large intensity had little effect on the larvae until a critical level was reached (equivalent to the intensity at late dusk or early dawn) when a vertical migration took place. A similar vertical migration took place when the natural light at dusk was beamed in; many larvae then moved to the surface and remained there, apparently very active throughout the night until the light increased at dawn. Vertical migration could be simulated in the laboratory at any time by imposing an artificial light-cycle of appropriate amplitude on the larvae. (Auth.)

17097. Kozlova, I. V. 1972. PLANKTON IN THE "OZERO AYATSKOYE" RESERVOIR AS A SOURCE OF FOOD FOR WHITEFISH. Hydrobiological Journal, 8(5): 31-39.

The dynamics of the composition, abundance, and biomass of Ozero Ayatskoye zooplankton was studied in relation to hydrological changes. The pH of the water was found to have a significant effect on it. Prey forms (56.5 to 90%) were dominant in the plankton throughout the year (except May). Intensive year-round consumption of plankton by planktonophages, by fishes with mixed nutrition, and by benthophagous fishes greatly reduce the food supply and at the most critical time (end of February) deplete Ozero Ayatskoye of almost all of its planktonic crustaceans. (Auth.)

17098. Ricker, W. E. (Fish. Res. Bd. of Canada, Biol. Sta., Nanaimo, British Columbia, Canada). 1973. TWO MECHANISMS THAT MAKE IT IMPOSSIBLE TO MAINTAIN PEAK-PERIOD YIELDS FROM STOCKS OF PACIFIC SALMON AND OTHER FISHES. J. Fish. Res. Bd. Canada, 30(9): 1275-1286.

"Mechanism 1" has two aspects: catches taken at a given rate of exploitation are greater when rate of exploitation has been increasing than when it has been steady or decreasing; also, the yield taken from the progeny of a spawning of a given size is greater when rate of exploitation has been increasing than when it has been steady or decreasing. "Mechanism 2" is the fact that mixtures of stocks of unequal productivity, when harvested together, produce smaller recruitments than single stocks of the same original size and having the same optimum rate of exploitation. In addition, any fishery for a valuable species is likely to develop beyond the optimum rate of exploitation because there is no easily detectable symptom that the optimum is being passed. When this has happened, maximum sustainable yield (MSY) will not be achieved immediately if the optimum rate is imposed subsequent to a period of overexploitation; rather there will be a gradual approach to MSY that extends over several generations after the optimum rate is established. Both of the two mechanisms above, plus the likelihood of unrecognized overfishing, make for a catch maximum while fishing is still on the increase. For salmon this maximum is likely to be 30-60% greater than the sustainable yield. In addition, unavoidable difficulties of management make for even greater differences between the historical maximum and the mean equilibrium yield that can be achieved in practice. Good annual prediction of recruitment can improve this picture because rate of exploitation can then be adjusted to the quantity of fish available; however this procedure too is much less effective when mixtures of stocks are fished in common, because in general the recruitments to different stocks do not vary in exactly the same way. The phenomena described may also contribute to an historical early maximum of catch in fisheries for species such as cod, being independent of and additional to the maximum caused by "removal of accumulated stock." (Auth.)

17099. Tagatz, Marlin E., and E. Peter H. Wilkens. 1973. SEASONAL OCCURRENCE OF YOUNG GULF MENHADEN AND OTHER FISHES IN A NORTHWESTERN FLORIDA ESTUARY. U. S. Dept. of Commerce, NOAA Technical Report NMFS SSRF-672, 14 p.

Gulf menhaden, Brevoortia patronus, and other species of fishes were collected by plankton net, seine, and surface trawl from Pensacola Bay, East Bay, and East Bay River from December 1969 to October 1971. Relative abundance, distribution, and relative growth of menhaden are given from the time they enter the estuary as larvae in December to the time they emigrate to the Gulf of Mexico as juveniles in September. Eighty-four species of fishes, representing 46 families, were captured. The number and length range of each species by month are presented for the areas from which it was caught. Also included are the salinity and temperature ranges at capture. Four species were not previously recorded from Pensacola estuaries. (Authors)

17100. Barclay, Lee A., Jr. (Auburn Univ., Auburn, Alabama 36830). 1973. STUDIES ON THE EFFECTS OF FINGERLING TAGS ON SMALL STREAM FISHES. Reprint from The ASB Bulletin, 20(2): p. 37.

Preliminary investigations were conducted to determine the effects of Floy Tag Company's new Fingerling Tag on 14 species of stream fishes from Choclafala Creek, Macon County, Alabama. Specimens used ranged from 50 to 120 mm in total length. Tagged fishes and controls were held in wire cages placed in a backeddy situation so that the effects of normally fluctuating stream currents could be monitored. Observations on the development of tag sores and associated fungal growths on the wounds were recorded. Tag sores in the form of deep, open depressions appeared to result from friction caused by current action on the tags. After eight weeks, percentage mortality of tagged fishes was as follows: Campostoma anomalum (50%), Ericymba buccata (100%), Nocomis leptocephalus (100%), Notropis baileyi (80%), N. bellus (100%), N. chrysocephalus (33%), N. venustus (100%), Hypentelium etowanum (50%), Moxostoma poecilurum (0%), M. erythrurum (40%),

Ictalurus punctatus (0%), Lepomis megalotis (50%), Micropterus salmoides (0%), and Percina nigrofasciata (40%). Mortality of control fishes was neglibible. From these preliminary data, it would appear that this tag is undesirable for long-term use with small stream fishes, particularly those which are current-dependent. Further investigations are being conducted. (Auth.)

17101. Falk, M. R., and M. J. Lawrence (Resource Management Branch, Central Region, Winnipeg, Manitoba, Canada). 1973. SEISMIC EXPLORATION: ITS NATURE AND EFFECT ON FISH. Dept. of Environ., Fisheries and Marine Service Central Region, Technical Report Series No.: CEN/T-73-9, 51 p.

The nature of seismic exploration in offshore and inland waterbodies of the Northwest Territories, as well as the effects on fish are covered in two parts. In the first part, literature pertaining to the nature and effect of explosive and non-explosive seismic energy sources is presented. The second part is concerned with a study of the effects that seismic energy sources commonly used in the Northwest Territories have on fish. Caged Arctic cisco (Coregonus autumnalis) and other small Coregonids were subjected to the energy sources to determine their lethal characteristics. Aquaflex (a linear high explosive) detonated in 165 foot lengths on the bottom in 10 ft of water, killed fish over an area of 36,200 square feet. A 10 pound charge of 60% Geogel (a point high explosive) detonated 10 ft below the surface in 15 feet of water, killed fish over an area of 25,450 square feet. In contrast, a 300 cubic inch Par Air Gun caused no direct fish mortalities. (Authors)

17102. Reimers, Paul E. (Mgmt and Res. Div., Fish Comm. of Oregon, Port Orford, Oregon 97465). 1973. THE LENGTH OF RESIDENCE OF JUVENILE FALL CHINOOK SALMON IN SIXES RIVER, OREGON. Research Reports of the Fish Comm. of Oregon, 4(2): 43 p.

This study was designed to provide life history information about juvenile fall chinook salmon, Oncorhynchus tshawytscha (Walbaum), in Sixes River, a small coastal river of Oregon, by 1) documenting the length of residence of the juveniles throughout the river, 2) exploring several factors possibly influencing their length of residence, and 3) assessing the relative importance of fresh-water and estuarine rearing areas for producing returning spawners. The juveniles were followed from their emergence in the spawning streams to their entry into the ocean. Most information on the length of residence of the juveniles was obtained by seining and trapping at various times and locations in the river. Spawning occurred mostly in the tributary streams, primarily in Dry Creek. Most fish spawned from November to January. Fry emerged from the gravel from March to May. Newly emerged fry moved downstream from the spawning areas in large numbers at night. Based on experimental studies of juvenile behavior, this movement apparently resulted from emergence at night and lack of visual orientation of the fry during darkness. Downstream movement was reduced during increased light levels (daylight or moonlight). This initial movement of fry is thought to assure rapid dispersal of juveniles throughout the river without extensive energy costs of dispersal by a social mechanism. Many juveniles remained in fresh water until early summer. Most then entered the estuary, possibly because of high temperature in the main river. A small number of fish continued to reside in the cool spawning tributaries. Detailed studies in 1969 showed that juveniles began entering the estuary in spring, but large increases in the population did not occur until June. During the period of increasing abundance, many juveniles were also captured in the ocean surf. The population level in the estuary peaked at about 145,000 fish during July and August and then declined to a low level in autumn. The rate of growth of the juveniles was reduced for 3 months during the period of high population abundance. Population density is hypothesized as a major cause of the depressed rate of growth of the juveniles. After the population declined in late summer, growth of juveniles again improved. Following the autumn freshets, most fall chinook salmon remaining in the estuary and those in the cool spawning streams entered the ocean. A few fish from the tributary populations remained in fresh water through the winter and migrated to the ocean as yearlings the following spring. Based on variation in the length of residence of juveniles in fresh water and the estuary, five types of life

histories were defined. Scale patterns from these types were distinguished and returning spawners from the 1965 brood sorted into the various types. The type-3 fish, those remaining in fresh water until early summer and then remaining for a period of improved growth in the estuary, represented about 90% of the returning spawners. Based on the return of these type-3 fish, fresh-water and estuarine rearing were concluded to be about equally important to fall chinook salmon in Sixes River. (Auth.)

17103. Brannon, E. L. 1972. MECHANISMS CONTROLLING MIGRATION OF SOCKEYE SALMON FRY. Bulletin No. 21 of the Internat'l Pacific Salmon Fish. Comm., New Westminster, British Columbia, Canada, 86 p.

The long and rigorous migrations of Pacific salmon through ocean and river to return to their spawning stream have attracted the attention of many observers. The migrations of young salmonid fry from their incubation site to their fresh-water rearing nursery area, not as well known, were investigated to elucidate the life history of these fish. Sockeye salmon fry from six areas in the Fraser River watershed were investigated to determine the causes of migratory behavior. Different migratory behavior patterns were displayed by fish from each of the six populations. Size and age were found not to be a causal mechanism; instead, responses were made to the current velocity of a stream. In addition, olfactory stimuli relating to source of water and odor influenced directional behavior. Temperature of the water, and light, influenced the intensity of the responses, but they were not directing factors. In the absence of current in the lake environment, light appeared to provide the stimulus for migration. The evidence provided by the study indicates that fry migration is a genetically based behavior pattern influenced by current velocities, olfactory stimuli, and other race specific factors. In the rehabilitation of areas barren of fish, migration behavior of sockeye fry must be also considered. (Auth.)

17104. Fee, Everett J. (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg, Manitoba R3T 2N6, Canada). 1973. MODELLING PRIMARY PRODUCTION IN WATER BODIES: A NUMERICAL APPROACH THAT ALLOWS VERTICAL INHOMOGENEITIES. J. Fish. Res. Bd. Canada, 30(10): 1469-1473.

A new model for computing integral daily phytoplankton primary production is described. The model incorporates vertical variations of algal biomass, complex photosynthesis vs. light responses, nonexponential extinction of light vs. depth, and any distribution of surface light over a day. The basic approach is to combine measured relations for photosynthetic rate vs. light, light vs. depth, and light vs. time in an interpolative scheme rather than attempting to fit equations to the data and using the resulting equations to obtain a mathematical solution. The model is general and should have wide applicability. Model predictions agreed well with in situ measurements of production. (Auth.)

17105. Eaton, John G. (U. S. Environ. Protection Agency, Nat'l Water Quality Lab., Duluth, Minnesota). 1973. CHRONIC TOXICITY OF A COPPER, CADMIUM AND ZINC MIXTURE TO THE FATHEAD MINNOW (Pimephales promelas Rafinesque). Water Research, 7(11): 1723-1736.

Fathead minnows were exposed to a series of concentrations of a copper, cadmium and zinc mixture during a 12.5 month chronic test in water of 200 mgl^{-1} total hardness. The metal concentrations in the mixture were selected on the basis of results obtained during previous chronic exposures to each of the metals individually in the same water. Strict summation of the chronic toxicities of the metals was not indicated when they were tested in combination. Toxic effects of the mixture attributable to copper appeared to be increased, but that attributable to cadmium was reduced. The effects thought to be due to zinc were similar in degree to those observed in the single chronic exposure. Summation of effects resulting from a mixture containing about the same proportions of copper, cadmium and zinc occurred at a much higher, acutely lethal concentration. A lethal threshold was attained in the mixture when each metal was present at a concentration of 0.4 or less of its individual lethal threshold. (Auth.)

17106. Pope, G. F., J. C. H. Carter, and G. Power (Dept. of Biol., Univ. of Waterloo, Ontario, Canada). 1973. THE INFLUENCE OF FISH ON THE DISTRIBUTION OF Chaoborus spp. (Diptera) AND DENSITY OF LARVAE IN THE MATAMEK RIVER SYSTEM, QUEBEC. Trans. Amer. Fish. Soc., 102(4): 707-714.

The distribution and limnetic density of five species of Chaoborus larvae were determined in 26 lakes of the Matamek River System, Quebec. The distribution of C. americanus is closely related to the absence of fish while C. punctipennis is associated with fish populations. The distributions of C. trivittatus and C. flavicans appear independent of the presence or absence of fish, but C. flavicans reaches its greatest density in the three lakes with the largest individual basins. A probable new species or subspecies of the subgenus Scadanophasma was found in three lakes. The standing crop of limnetic Chaoborus larvae is higher in lakes without fish than with fish. (Authors)

17107. Tugarina, P. Ya., and Anudarin Dashidorzhi (Dept. of Zool., Irkutsk and Mongolian State Universities, USSR). 1972. THE MONGOLIAN GRAYLING [Thymallus brevirostris (Kessler)] OF THE DZABKHAN RIVER BASIN. J. Ichthyol. 12(5): 774-786.

A complete morphological and systematic diagnosis of the Mongolian grayling (Thymallus brevirostris Kessler) found in northwestern Mongolia is given for the first time. The lack of sexual dimorphism, the anatomical and biological characteristics enable the authors to provide a diagnosis of the species. This species is primitive and has narrow ecological valency. We believe it is a Tertiary relict of the freshwater fauna of northwestern Mongolia.

17108. Chittenden, Mark E., Jr. (Dept. of Environ. Sci., Rutgers Univ., New Brunswick, New Jersey). 1973. SALINITY TOLERANCE OF YOUNG AMERICAN SHAD, Alosa sapidissima. Chesapeake Science, 14(3): 207-210.

Young American shad were subjected to abrupt and gradual changes between saltwater and freshwater media. No mortality occurred with salinity increase, even abrupt change from fresh water or 5 °/oo salinity to about 30 °/oo salinity. Complete mortality occurred with abrupt salinity decrease from about 30 to 0 °/oo but not with gradual decrease from about 5 to 0 °/oo. Young American shad tolerate salinity change, especially salinity increase. Instances of apparent intolerance of salinity change reported in the literature and observed by myself may be primarily due to handling stress. Euryhaline ability permits American shad to use brackish and freshwater nurseries. The importance of brackish nurseries probably depends on the rate of seaward dispersal of the young and the proximity of brackish water to the chief spawning grounds. (Auth.)

17109. Crim, Laurence W., Roland K. Meyer, and Edward M. Donaldson (Dept. of Zool., Univ. of Wis., Madison, Wisconsin). 1973. RADIOIMMUNOASSAY ESTIMATES OF PLASMA GONADOTROPIN LEVELS IN THE SPAWNING PINK SALMON. General and Comparative Endocrinology, 21(1): 69-76.

A radioimmunoassay technique for measuring salmon gonadotropin is described. The method has been validated by comparing relative potency values of pituitary preparations in both bioassay and radioimmunoassay systems as well as establishing parallelism of dose-response curves obtained for standard salmon gonadotropin, pituitary, and plasma samples. A preliminary study to determine the plasma gonadotropin levels in pink salmon during the period of gonadal growth and development indicated that sexual maturity, including the events of ovulation or spermiation, is associated with an increased secretion of gonadotropin. (Authors)

17110. Ohno, S., L. Christian, M. Romero, R. Dofuku, and C. Ivey (Dept. of Biol. City of Hope Medical Center, Duarte, California 91010). 1972. ON THE QUESTION OF AMERICAN EELS, Anguilla rostrata VERSUS EUROPEAN EELS, Anguilla anguilla. Experientia, 29(7): p. 891.

The American eel Anguilla rostrata (2n = 38; 20M + 18A) belongs to a different species than the European Anguilla anguilla (2n = 38; 32M + 6A). (Authors' summ)

17111. Brungs, William A. (Nat'l Water Quality Lab., Environ. Protection Agency, Duluth, Minnesota). 1973. EFFECTS OF RESIDUAL CHLORINE ON AQUATIC LIFE. J. Wat. Poll. Contr. Fed., 45(10): 2180-2193. (Contains excellent biblio.)

Increased use of chlorine and recent studies of residual chlorine toxicity in aquatic systems have emphasized the need for close scrutiny of present disinfection procedures. This review discusses chlorine uses and chlorine chemistry and emphasizes toxicity studies in the field and in the laboratory. Interim criteria, based on knowledge to date, for permissible concentrations of total residual chlorine are: (a) in areas receiving wastes treated continuously with chlorine, not to exceed 0.01 mg/l for the protection of more resistant organisms only, or not to exceed 0.002 mg/l for the protection of most aquatic organisms; and (b) in areas receiving intermittently chlorinated wastes, not to exceed 0.2 mg/l for a period of 2 hr/day for more resistant species of fish, or not to exceed 0.04 mg/l for a period of 2 hr/day for trout and salmon. If free chlorine persists, more restrictive criteria are warranted. Alternate procedures or substitutes for chlorination should be investigated. (Auth.)

17112. European Inland Fisheries Advisory Commission (Working Party on the Preparation of a Review on Salmon and Trout Feeds and Feeding, FAO, Rome, Italy). 1971. SALMON AND TROUT FEEDS AND FEEDING. EIFAC Technical Paper No. 12, 29 p.

A condensed survey is given from the available knowledge on the requirements of salmonidae for proteins (amino acids), fats (fatty acids), carbohydrates, minerals, vitamins, water and energy. As far as possible those requirements are expressed in facts and figures. The requirements for amino acids, fatty acids and vitamins are reasonably well-known. There is a great demand for more information on minerals, carbohydrates and on the energy metabolism. Moreover the requirements of the breeders are more or less still completely unknown. The nutritional requirements of the fishes should be met by the feed. Therefore, the composition of the raw materials and the composition of the complete diet is of the utmost importance. Detailed information is given about the composition of commonly used ingredients and some examples are given of complete diets. Quite extensively the quality criteria are discussed for the different classes of nutrients. Moreover problems with the moisture content, the mineral content, the mould growth, the contamination and toxic compounds are discussed in detail, as being major problems for the future. Finally a general approach to medicated fish food is given. The physical properties of fish foods (sinking, floating, water stability, and so on) are still very important items, and a lot of information has still to be gained in relation to it. The feeding behaviour seems to be a key-point which should get far more attention. The storage of fish foods is discussed in detail. The economic evaluation of complete fish foods is still very difficult and needs a collaboration with economists. Methods to evaluate the performance of the fish are also given. The relative value of feeding charts and schedules is discussed and some examples are given. (Authors' summ.)

17113. Plumb, John A. (Dept. of Fish. and Allied Aquaculture, Agric. Exp. Sta., Auburn Univ., Auburn, Alabama). 1973. NEUTRALIZATION OF CHANNEL CATFISH VIRUS BY SERUM OF CHANNEL CATFISH. J. Wildl. Diseases, 9(4): 324-330.

Sera from 71 adult channel catfish (Ictalurus punctatus), with a history of channel catfish virus (CCV) association, were assayed for CCV neutralization activity. Sixty-seven serum samples had positive CCV neutralization indices. Sera from 10 fish with no known history of CCV exposure, showed no evidence of virus neutralization activity. Viable CCV was not isolated from 232 organs or excretory products of studied fish. Serum from channel catfish experimentally immunized with viable CCV reached peak neutralization indices 60 days after virus injection. Detection of CCV serum neutralization activity can afford a possible method of identifying channel catfish populations with a previous exposure to CCV. (Auth.)

17114. Davis, Robert M. (Natural Resources Inst., Univ. of Maryland, College Park, Maryland). 1973. BENTHIC MACROINVERTEBRATE AND FISH POPULATIONS IN MARYLAND STREAMS INFLUENCED BY ACID MINE DRAINAGE. Nat. Res. Inst., Univ. of Maryland, Contribution No. 528, 103 p.

Acid mine drainage for many years has been the greatest source of stream pollution in Allegany and Garrett Counties, Maryland. To assess water quality and inventory benthic macroinvertebrates, as well as fish populations in streams affected by acid mine drainage, a study was initiated in 1969 and completed in 1971. The area studied included the Youghiogheny River, Cherry Creek, Savage River, Casselman River, Potomac River, Georges Creek and Wills Creek. These watersheds receive all the drainage from the coal mines of Maryland. Fifteen taxa of benthic macroinvertebrates and 39 species of fish were identified during the study. Diptera and Tricoptera were the dominant benthic groups, while cyprinids were the dominant fishes. Benthic macroinvertebrates and fish populations in acid mine waters showed considerable variation in numbers of individuals and species diversity. Benthic macroinvertebrate fauna were found in both clean-water stations and with the exception of Aaron Run, in all stations polluted by acid mine drainage. However, standing crop and species diversity values were distinctly lower at stations heavily polluted by acid mine drainage. The mean number of individuals/ft varied from 9 (range 0 - 48) at heavily polluted stations to 53 (range 1 - 269) at clean-water stations. Mean species diversity ranged from 0.79 (range 0 - 1.53) at heavily polluted stations to 2.17 (range 1.69 - 2.77) at clean-water stations. Stations with the poorest water quality, due to large quantities of acid mine drainage, had no fish whereas clean-water stations averaged 175 individuals per station (range 13 - 597) and species diversity averaged 1.74 (range 0.60 - 2.44). Stations receiving intermittent acid mine drainage generally had larger standing crops of benthos, although fish were not always present. The Potomac River, Georges Creek, and Wills Creek watersheds were the most severely affected by acid mine drainage. Fish were absent from a number of stations and benthic fauna was sparse and diversity was low. Conditions in the Youghiogheny and Casselman River Watersheds have vastly improved over those found in the late 1950's. Some light acid inflow continues to enter both watersheds, but moderately diverse benthic and fish faunas were present. (Auth.)

17115. Van Meter, Harry D. (U. S. Fish & Wildl. Service, Sandusky Biol. Sta., Sandusky, Ohio 44870). 1973. UNHARVESTED FISHES IN THE U. S. COMMERCIAL FISHERY OF WESTERN LAKE ERIE IN 1969. U. S. Dept. of Commerce, NOAA Technical Report NMFS SSRF-670, 11 p.

Potential commercial fish production was estimated for U. S. waters of western Lake Erie in 1969 from pounds landed and pounds discarded. Periodic observations of catches in haul seines and trap nets revealed that about 37% of the catch (by weight) in haul seines and 26% of that in trap nets were low-value fishes that were discarded. Projection of these discarded catches to include the total fishing effort indicated that an additional 2.8 million lb of low-value species would have been landed in 1969 if a reasonable profit had been assured. It is concluded that the sustained yield could be increased considerably with only a moderate increase in fishing effort. (Auth.)

17116. Perrier, Henri, J. P. Delcroix, C. Perrier, and J. Gras (Dept. of Pharm. Biochem., Univ. Claude Bernard, U. E. R. of Pharm. Sci., Lyon, France). 1973. AN ATTEMPT TO CLASSIFY THE PLASMA PROTEINS OF THE RAINBOW TROUT (Salmo gairdnerii Richardson) USING DISC ELECTROPHORESIS, GEL FILTRATION AND SALT SOLUBILITY FRACTIONATION. Comp. Biochem. Physiol., 46(3B): 475-482.

Rainbow trout plasma proteins were studied by means of three analytical procedures. Disc electrophoresis with 9% acrylamide separation gel visualizes thirteen main bands. Gel filtration with Sephadex G-200 yields three elution groups. The salt solubility fractionation was carried out by ammonium sulfate treatment between 25 and 65 percent saturation. Collecting the results together, a classification is proposed. Considering the physical characters of proteins, eight groups are distinguishable. (Authors)

17117. Scott, W. B., and E. J. Crossman (Dept. of Ichthyology and Herpetology, Royal Ontario Museum, Toronto, Ontario, Canada). 1973. FRESHWATER FISHES OF CANADA. Fish. Res. Bd. of Canada, Ottawa, Bulletin 184. Available from Information Canada, Ottawa Canada, $9.75 clothbound, 980 pages.

For many years there has been an acute need for a publication on the identification, distribution, biology, and economic importance of the freshwater fishes of Canada. This book provides facts and figures on all species occurring in Canadian fresh waters. The descriptions are based on examinations of specimens carried out expressly for the preparation of this book. For many species the maps will be the first graphic presentation of their Canadian range, and the world distribution is given if the natural range extends beyond Canadian boundaries. Most of the drawings were prepared especially for this book, using typical examples of each species for reference. The artists have been unusually successful in achieving a high degree of accuracy and realism. The keys to the identity of the various fishes were prepared specifically for Canadian fishes and have been tested for more than three years. They include more than one character in each choice in an attempt to separate all of the fishes occurring over the whole of such a large country. Over 1400 references and special Suggested Reading sections cover most of the literature on Canadian freshwater fishes.

17118. Dlugosz, Miroslawa. 1973. DEVELOPMENT OF BLOOD CELLS OF THE ERYTHROCYTIC AND LEUCOCYTIC SYSTEMS IN THE RAINBOW TROUT (Salmo gairdneri Richardson 1836) DURING THE PERIOD FROM CLOSING OF THE BLASTOPORE TILL HATCHING OF LARVAE. Roczniki Nauk Rolniczych, 95(2): 17-26. In Polish with English synopsis and summary.

Results of histological-hematological and cytochemical investigations into morphology of blood cells in rainbow trout during the period from larva hatching till resportion of the yolk sac. Two generations of erythrocytes were found to occur at that time. These were the primary forms characteristic of the embryonic period, and the secondary forms that appeared just after larva hatching. Unilobate and multilobate leucocytes and lymphocytes were found to occur in the leucocytic system. Panchromatic staining by MGG method did not reveal any granulation in the cytoplasm of leucocytes of the rainbow trout larva. (Auth. synopsis)

17119. Mississippi State University (Depts. of Biochemistry, Entomology, and Zoology, State College, Mississippi). 1972. LEVELS OF CHLORINATED HYDROCARBON IN CATFISH IN ALABAMA, ARKANSAS, FLORIDA, GEORGIA, LOUISIANA AND MISSISSIPPI. Available from NTIS as COM-72 10669. Dept. of Comm. Economic Development Admn. Tech. Assistance Project Report, April 1972, 44 p.; Selected Water Resources Abstracts, 6(22): p. 48.

Pesticide residues in commercial catfish in Southeastern United States were monitored and uptake (food and water), tissue distribution, and elimination of selected chlorinated hydrocarbons by channel catfish determined. Virtually every sample contained p, p'-DDE. Its parent compound, p, p'-DDT, appeared in all muscle samples and in 93% of the liver samples. In laboratory studies, catfish were treated in low concentrations of DDT, Mirex or toxaphene in water; water was sampled at 0, 1, 3, and 6 weeks and fish at 1, 3, and 6 weeks to determine pesticide concentration. DDT, Mirex, and toxaphene were dissolved in sufficient hexane to insure complete penetration of commercial catfish food pellets to determine the catfish uptake and release of the insecticides through food. Of tissues assayed, pesticide residues were consistently lower in muscle than in other tissues regardless of route or length of exposure. Highest residue levels were in blood and brain. In water, Mirex was distributed to and retained in muscle to a much lesser extent than was toxaphene and DDT. In all instances, exposure through food resulted in higher residue levels. Biological magnification in the food web represents a more serious threat than residues in water.

17120. Howell, W. Mike, and Stephen E. Bloom (Sect. of Ecol. and Syst., Langmuir Lab., Cornell Univ., Ithaca, New York). 1973. SEX-ASSOCIATED DIFFERENTIAL FLUORESCENCE OF MUDMINNOW CHROMOSOMES AND SPERMATOZOA. Nature, 245(5423): 261-263.

17121. Wekell, Marleen M. B., and G. W. Brown, Jr. (Coll. of Fish., Univ. of Wash., Seattle, Washington). 1973. ORNITHINE AMINOTRANSFERASE OF FISHES. Comp. Biochem. Physiol., 46(4B): 779-795.

The activity of ornithine aminotransferase was measured in liver and other tissues from a number of species of fish. Significant levels of the enzyme were detected in many of the species investigated. The fish enzyme appears to be similar to the enzyme found in higher animals. The fish enzyme is inhibited by heavy metals and is especially sensitive to mercury. The fish enzyme is decreased by starvation in a teleost and elasmobranch; examination of this enzyme level in fishes can be a useful measurement of the quality of the diet. The implication of these findings for the concept of ureotelism is discussed. (Authors)

17122. Molnar, K. (Vet. Med. Res. Inst., Hungarian Acad. Sci., Budapest, Hungary). 1970. AN ATTEMPT TO TREAT FISH BOTHRIOCEPHALOSIS WITH DEVERMIN. Acta Veterinaria Acad. Sci., Hungaricae, 20(3): 325-331; Fish Health News, 2(4): p. 8.

Devermin known as an excellent anthelminthic against the cestodes of warm-blooded animals, proved similarly efficient for the control of fish cestodes. In a dose of 0.1 g for 1 kg fish, it provided a practically 100% eradication of tapeworms after treatment of the fishes on two occasions. While the enteric toxicity of Devermin was very low, its aqueous solution proved to be fatally toxic for fishes in a concentration as low as 10^{-6}. To prevent the possible toxic effect of dissolved Devermin on feed medication, its application should be limited either to large ponds or to those with appropriate through-flow of the water supply. (Auth.'s summ.)

17123. Spratt, Jerome D. 1973. AGE AND LENGTH COMPOSITION OF NORTHERN ANCHOVIES, Engraulis mordax, IN THE CALIFORNIA REDUCTION FISHERY FOR THE 1971 - 72 SEASON. Calif. Fish and Game, 59(4): 293-298.

A total of 53,426 tons of anchovies was landed for reduction during the 1971 - 1972 season. Sampling revealed that the catch was dominated by age groups I and II in southern California and I, II, and III in central California.

17124. Tyus, Harold M. (Dept. of Zool., N. C. State Univ., Raleigh, North Carolina). 1973. ARTIFICIAL INTERGENERIC HYBRIDIZATION OF Ambloplites rupestris (CENTRARCHIDAE). Copeia No. 3, pp. 428-430.

Artificial hybridization was used to explore phylogenetic relationships of Ambloplites rupestris, the rock bass and five other species of sunfishes: Pomoxis nigromaculatus, Lepomis macrochirus, Enneacanthus obesus, Lepomis (or Chaenobryttus) gulosus and Micropterus salmoides. The degree of hatching success was interpreted as an indication of phylogenetic closeness when equated with a control cross value of each spawn of eggs. Cleavage data were only generally related to hatching success. Hatching percentages of hybrid crosses were adjusted to the control cross percentages of the same spawn of eggs. Hatching success suggests that the phylogenetic relationships of other species to Ambloplites rupestris from most successful hybridization to least successful were: Pomoxis nigromaculatus; Lepomis macrochirus, and Enneacanthus obesus; Lepomis (or Chaenobryttus) gulosus; Micropterus salmoides. (Auth.)

17125. Cameron, James N. (Univ. of Alaska, Inst. of Arctic Biol., Fairbanks, Alaska). 1973. OXYGEN DISSOCIATION AND CONTENT OF BLOOD FROM ALASKAN BURBOT (Lota lota), PIKE (Esox lucius) AND GRAYLING (Thymallus arcticus). Comp. Biochem. Physiol., 46(3A): 491-496.

Oxygen dissociation curves of whole blood were determined for northern pike, burbot and grayling from interior Alaska. Temperature was either 5, 10 or 15°C, and CO_2 tensions were in the physiological range of 0-7.0 torr. P_{50} values ranged from 3.2 to 30.6 for burbot, from 2.7 to 7.3 for pike and from 10.0 to 25.0 for grayling. P_{50} was 6.8 for three long-nosed suckers at 10°C. (Auth.)

17126. Lotrich, Victor A. (Dept. of Zool., Univ. of Kentucky, Lexington, Kentucky). 1973. GROWTH, PRODUCTION, AND COMMUNITY COMPOSITION OF FISHES INHABITING A FIRST-, SECOND-, AND THIRD-ORDER STREAM OF EASTERN KENTUCKY. Ecological Monographs, 43(3): 377-397.

Fish populations in a first-order, a second-order, and a third-order stream were studied during the summers of 1967-68. The primary food of each fish species was determined. Available food sources included terrestrial invertebrates, aquatic primary production, aquatic invertebrates, aquatic vertebrates, and detritus. Average daily growth rates showed that age-group I fish of most species grew faster in early than in late summer. The growth rate of most age-group II fish varied little between these seasons. Total numbers, total standing crop, and gross production were estimated for each species in each order. Total production was compared among stream orders on a per linear meter basis. Production values were nearly equal in first (2.35 g dry weight per linear meter) and second order (2.36), but increased in third order (3.29). The relative importance of terrestrial invertebrates as an energy source decreased with increasing stream order. Aquatic primary production and aquatic invertebrates began to be utilized as energy sources in second order. The aquatic vertebrates and detritus began to be utilized in third order. The relative importance of aquatic primary production utilization increased in third order, but the relative importance of aquatic invertebrate utilization was approximately the same as in second order. The community structure of the fish populations of each pool was analyzed with information theory and the ratio H/H_{max}. Community structure differed between third-order and second-order pools even when the same species complement was present. It is postulated that stream order in most cases represents a biological unit which can be subdivided into microhabitats based on riffle, pool, type of substrate, etc., and addition in most cases proceeds by discrete units of stream order. (Auth.)

17127. Boyar, H. C., R. R. Marak, F. E. Perkins, and R. A. Clifford (NMFS Northeast Fish. Center, NOAA, Dept. of Commerce, West Boothbay Harbor, Maine 04575). 1973. SEASONAL DISTRIBUTION AND GROWTH OF LARVAL HERRING (Clupea harengus L.) IN THE GEORGES BANK-GULF OF MAINE AREA FROM 1962 TO 1970. J. Cons. int. Explor. Mer., 35(1): 36-51.

This study reports observations made on the seasonal distribution of larval herring in the western North Atlantic from November 1962 through April 1970. It summarizes observations made during all months of the year except January and provides a more complete picture than previous studies conducted in autumn, winter, and spring of the 1950's. The seasonal distribution of larval herring from the autumn through the spring (combined with maturity, meristic and biochemical studies of adult herring in the 1960's) provides evidence of at least three discrete major spawning areas in the western North Atlantic: Georges Bank, coastal Gulf of Maine and Nova Scotia. The presence of a clockwise gyre, although it may at times break down in the winter, on Georges Bank retains the majority of larvae spawned on the Bank. The presence of a counter-clockwise current in the coastal Gulf of Maine appears to retain the larvae in these waters and the circulation off the coast of Nova Scotia results in the larvae remaining close to the spawning site or being carried into the Bay of Fundy. Larvae grow at least to a length of 50 to 55 mm (TL) before becoming post-larvae. They grow on the average of 5 mm per month from September through June. (Authors)

17128. Calamari, Davide, and Roberto Marchetti (Istituto di Ricerca sulle Acque (C.N.R.), Sezione Idrobiologia Applicata, Milano, Italy). 1973. THE TOXICITY OF MIXTURES OF METALS AND SURFACTANTS TO RAINBOW TROUT (Salmo gairdneri Rich.). Water Research Pergamon Press, 7(10): 1453-1464.

The toxicity to rainbow trout of two metals (copper and mercury) and three detergents (two anionics and one non-ionic) were determined with an exposure period of 14 days. Each compound was tested separately and as a metal-detergent pair. The results show that for the mixtures of anionic detergents and metals a "more-than-additive" effect exists, while for the mixture of non-ionic detergent and metal the toxic effect is probably "less-than-additive". These findings are compared with existing data in the literature and the underlying reasons for these effects are discussed. (Authors)

17129. Gilderhus, Philip A., Bernard L. Berger, Joe B. Sills, and Paul D. Harman. 1973. THE EFFICACY OF QUINALDINE SULFATE AS AN ANESTHETIC FOR FRESHWATER FISH. U. S. Dept. of the Interior, Bur. of Sport Fish. and Wildl. Investigations in Fish Control No. 49, 9 p.

Quinaldine sulfate ($QdSO_4$), an improved formulation of the fish anesthetic quinaldine, was tested for its efficacy on 15 species of freshwater fish. The new crystalline formulation is water soluble and thus easier to use than is practical grade quinaldine. $QdSO_4$ anesthetizes most salmonids at 25 mg/l in less than 4 minutes and the fish recover in 1 to 13 minutes in fresh water. The effective concentrations for several warmwater species varied from 15 mg/l for bluegills to 60 mg/l for channel catfish. Fish were held for up to 60 minutes in effective concentrations without suffering mortalities. The efficacy of the anesthetic was little affected by water temperature, but the compound lowers the pH of some soft waters to below 6, the point at which it becomes ineffective as an anesthetic. All fish retained some reflex action and thus, some large fish were difficult to handle. (Authors)

17130. Gibson, R. N. (The Dunstaffnage Marine Res. Lab., Oban, Argyll, Scotland). 1973. THE INTERTIDAL MOVEMENTS AND DISTRIBUTION OF YOUNG FISH ON A SANDY BEACH WITH SPECIAL REFERENCE TO THE PLAICE (Pleuronectes platessa L.). J. exp. mar. Biol. Ecol., 12(1): 79-102.

The intertidal movements of young fish were studied on a sandy beach over several tidal cycles during the day and the night. Young plaice (Pleuronectes platessa L.), by virtue of their abundance, received the most attention, and it was found that they migrate up and down the beach with each tide in company with several other less abundant species. The dab (Limanda limanda (L.)), does not make this migration. The vertical distribution of the commoner fish species was charted and each was found to occupy a specific zone in relation to the water, but with large overlaps in many cases. A close relationship between the length of plaice and dabs and the depth in which they were caught was evident during the summer months, but this relationship broke down in the winter due mainly to an offshore movement of larger fish. The food intake of plaice was studied throughout the day and night; feeding occurred mostly during the day. No effect of the tide on feeding could be detected. The possible mechanisms controlling the tide-related movements and the size-depth relationship are discussed and a general hypothesis is put forward in which it is proposed that the fish are able to select and maintain their position at a particular depth throughout a tidal cycle thereby being guided up and down the beach. Attributes of depth which the fish might use as a reference point in their movements are discussed. (Auth.)

17131. Platts, William S. (USDA, Forest Service, 1075 Park Blvd. Boise, Idaho 83706). 1970. THE EFFECTS OF LOGGING AND ROAD CONSTRUCTION ON THE AQUATIC HABITAT OF THE SOUTH FORK SALMON RIVER, IDAHO. Fiftieth Ann. Conf. of the Western Assn. of State Game & Fish Commissioners: 182-185.

From 1962 through 1967, the streambed fine sediment content increased 100 percent in the upper 25 miles of the river, and from streambed surface and depth analysis of fine sediment, it appears a similar increase occurred in most of the river system. This accelerated increase in fine sediment resulted from logging and road construction activities that removed 325 million board feet of timber from about 10 percent of the study area. Prior to salmon spawning, substrate used for redds averaged about 20 percent fine sediment (0.83 mm). The stream channel surface material in the spawning areas averaged 48 percent sediment less than 9.51 mm. Sampling in redd areas after salmon spawning showed that salmon were not capable of eliminating the required amount of fine sediment from the redds to gain good water permeability. A pool in the river was excavated of its accrued sediment (16,016 cubic yards) at a cost of $20,000 in an effort to contain downstream moving fine sediment. The project was futile because it completely filled with sediment within six months and was only 15 to 30 percent effective in containing downstream moving sediment. (Auth.)

17132. Emerson, Steve, Wallace Broecker, and D. W. Schindler (Lamont-Doherty Geological Observatory of Columbia Univ., Palisades, New York 10964). 1973. GAS-EXCHANGE RATES IN A SMALL LAKE AS DETERMINED BY THE RADON METHOD. J. Fish. Res. Bd. Canada, 30(10): 1475-1484.

The radon method, used previously in ocean-atmosphere systems, is used here to determine the gas-exchange rate between the atmosphere and lake 227 of the Experimental Lakes Area. Fertilization of the lake with nitrogen and phosphorus caused the carbon dioxide partial pressure in the lake water to drop well below atmospheric levels; hence, in order to better understand the carbon budget of the lake, an estimate of the CO_2 gas-exchange rate was necessary. To determine gas-exchange rates by measuring radon evasion to the atmosphere the source of radon in the lake water must be dissolved radium. Since the radon concentration in lakes derives not only from the decay of dissolved radium but also from the inflow of radon-rich groundwaters, radium was added to the lake to increase the radon concentration well above this fluctuating background level. Although this procedure was complicated by algal uptake of the radium in the lake (Emerson and Hesslein 1973), we were able to place limits on the gas-exchange rate. Our results indicate that the "stagnant boundary layer" thickness is approximately 300 μ. This value is among the largest observed in natural waters. Using this value and the partial pressure of CO_2 in the lake water we have calculated an invasion rate of 17 $\pm$ 8 mmoles CO_2/m^2 day. (Authors)

17133. Lee, D. J., and G. B. Putnam (Dept. of Food Sci. and Technology, Oregon State Univ., Corvallis, Oregon 97331). 1973. THE RESPONSE OF RAINBOW TROUT TO VARYING PROTEIN/ENERGY RATIOS IN A TEST DIET. Journal of Nutrition, 103(6): 916-922; U. S. Dept. of Comm., Marine Fisheries Abstracts, 26(10): p. 32.

Nine semipurified diets containing protein/energy ratios that ranged from 73 to 162 mg protein/kilocalories were fed to young rainbow trout for 18 weeks. A casein-gelatin (70-30) mixture and herring oil were each fed at three levels in a factorial type of experiment. Each of the casein-gelatin levels (36, 44 and 53%) was fed at each of the fat levels (8, 16 and 24%). Cornstarch was added at the expense of the casein-gelatin mix to adjust dietary protein levels. Caloric intake regulated feed consumption; and except for diets low in both fat and protein, no significant differences in weight gains were noted, although feed and energy conversions were markedly influenced. Higher protein/calorie ratios were positively correlated with liver size, level of liver sugars, percentage body fat, percentage body protein, and negatively correlated with percentage liver lipids, size of gastrointestinal tract and gain/gram ingested protein. These correlations were observed for similar protein/calorie ratios regardless of the dietary levels of protein and lipid. (Authors)

17134. Taylor, Robert E. L., Sebastian J. Coli, and Donald R. Junell (An. Sci. Dept., Univ. of Nevada, Reno, Nevada). 1973. ATTEMPTS TO CONTROL WHIRLING DISEASE BY CONTINUOUS DRUG FEEDING. Journal of Wildlife Diseases, 9(4): 302-305.

Six drugs were fed continuously to susceptible trout held in known Myxosoma cerebralis contaminated water in an attempt to prevent infection. Drug efficacy was judged by comparing numbers of spores which developed in medicated and non-medicated fish. Fish after having been fed furazolidone in two tests had fewer spores than the other groups. (Authors)

17135. Edwards, D. J. (Fish. Res. Div., Min. of Agric. and Fish., P. O. Ngapuna, Rotorua, New Zealand). 1973. AQUARIUM STUDIES ON THE CONSUMPTION OF SMALL ANIMALS BY 0-GROUP GRASS CARP, Ctenopharyngodon idella (Val.). J. Fish Biol., 5(5): 599-605.

In aquarium experiments common invertebrates from streams and ponds were offered to 0-group grass carp, Ctenopharyngodon idella (Val.) in the presence of palatable plants. When there was no cover for the prey to hide under, the carp ate many of the invertebrates, but when stones were provided, considerably more invertebrates escaped. Rainbow trout eggs were not eaten, but trout fry were taken as soon as they had emerged from artificial spawning redds. While searching for food, grass carp never disturbed the stones covering possible food organisms. (Auth.)

17136. Fast, Arlo W. (Mich. State Univ., East Lansing, Michigan). 1973. EFFECTS OF ARTIFICIAL HYPOLIMNION AERATION ON RAINBOW TROUT (Salmo gairdneri Richardson) DEPTH DISTRIBUTION. Trans. Amer. Fish. Soc., 102(4): 715-722.

Hemlock Lake, a eutrophic and meromictic Michigan lake, was artificially aerated by hypolimnetic aeration. This aeration system involved a special aeration tower and compressed air injection. Hypolimnetic oxygen concentrations increased from zero to saturation during aeration. Thermal stratification was gradually reduced by the aeration, but the lake remained thermally stratified for 10 weeks during aeration. Before aeration, rainbow trout (Salmo gairdneri Richardson) were limited to shallow depths by the anaerobic hypolimnion. They distributed to the deepest depths soon after aeration began and occupied the entire lake during artificial aeration. (Auth.)

17137. Tereshenkov, I. I. (State Res. Inst. for Lake and River Fish. (GosNIORKh), Leningrad, USSR). 1972. REPLACEMENT OF TEETH IN THE PIKE [Esox lucius (L.)]. J. Ichthyol., 12(5): 807-812.

Replacement of teeth, occurring throughout life irregularly and continuously, which is a species adaptation, has been established in the pike (Esox lucius L.) of different ages and sex from various lakes. The feeding of the pike is not connected with the replacement of the teeth, but continues all year at a rate influenced by the availability of prey and by environmental factors, mainly water temperature.

17138. Cross, F. A., L. H. Hardy, N. Y. Jones, and R. T. Barber (NOAA, NMFS, Atlantic Estuarine Fish. Center, Beaufort, North Carolina 28516). 1973. RELATION BETWEEN TOTAL BODY WEIGHT AND CONCENTRATIONS OF MANGANESE, IRON, COPPER, ZINC, AND MERCURY IN WHITE MUSCLE OF BLUEFISH (Pomatomus saltatrix) AND A BATHYL-DEMERSAL FISH Antimora rostrata. J. Fish. Res. Bd. Canada, 30(9): 1287-1291.

Concentrations of mercury (Hg) increased significantly with size ($P < 0.001$) in white muscle of bluefish (Pomatomus saltatrix) and a bathyl-demersal fish Antimora rostrata but concentrations of manganese (Mn), iron (Fe), copper (Cu), and zinc (Zn) either remained constant or decreased. These results indicate that fish residing in two different ecosystems in the Atlantic Ocean may be in a steady state with their environment with respect to Mn, Fe, Cu, and Zn but not Hg. The observed variations in accumulation patterns of trace metals in muscle of these two species as a function of size are discussed. (Authors)

17139. Hughes, G. M., and Miriam Morgan (Res. Unit for Comparative Animal Respiration, The Univ., Woodland Road, Bristol BS8 1UG, England). 1973. THE STRUCTURE OF FISH GILLS IN RELATION TO THEIR RESPIRATORY FUNCTION. Biol. Rev., 48(3): 419-475.

The general structure of the gills of different fishes is compared and it is concluded that, though essentially the same, there are certain differences by which they can be recognized. Possible ways in which they may be evolved from one another are considered. A detailed account is given of the structure of the secondary lamellae, where gaseous exchange takes place, and it is shown that two epithelial sheets are separated by a vascular axis mainly composed of pillar cells overlain by a basement membrane on each side. Blood pathways through the gills are discussed in relation to their respiratory function. The embryonic development of gills is described and evidence regarding homologies of different structures, particularly the pillar cells, is reviewed. The gills of fish having different modes of life show variations in (a) the number of arches, (b) the number and length of the gill filaments, and (c) the size and frequency of the secondary lamellae. Ways in which measurements of gill area may be carried out and some of the complications involved are reviewed and a summary given of measurements for a wide variety of species. Measurements of the thickness of the water-blood barrier are also discussed; the more active fish generally have thinner water-blood barriers and larger gill areas. The different mechanisms of gill ventilation are summarized and characteristics of gill resistance in elasmobranchs and teleosts are compared. Gas exchange is discussed in relation to available techniques and the current

terminology and symbols, and to indicate the value of analogies between gill exchangers and systems studied by engineers. It is outlined how studies of the functioning of gills during coughing, parasitic infection, and in polluted waters add to knowledge of their role in respiration. (Authors' summ.)

17140. Kleerekoper, H. (Texas A & M Univ., College Station, Texas). 1973. EFFECTS OF COPPER ON THE LOCOMOTOR ORIENTATION OF FISH. Environmental Protection Agency, Ecological Research Series Report EPA-R3-73-045, 97 p., available from GPO Sup. Doc. as EP1.23:73045, $1.25; Selected Water Resources Abstracts, 6(21): p. 69.

The effects of copper ions at subacute concentrations on the locomotor orientation of goldfish (Carassius auratus), channel catfish (Ictalurus punctatus, largemouth bass (Micropterus salmoides), white sucker (Catostomus commersoni commersoni) and green sunfish (Lepomis cyannelus) were investigated in detail. In regions of water containing 11-17 micrograms/l Cu++ (as CuCl2) in a shallow gradient goldfish oriented toward the copper source ('attraction'). This response is reduced in a somewhat steeper gradient. In steep gradients significant but no absolute avoidance behavior occurred. Whether the response will be 'avoidance' or 'attraction' seems to depend on the slope of the gradient to which the fish is exposed. Even in steep gradients, the 'avoidance' behavior is reversed to 'attraction' when the copper ions interact with a temperature slightly higher (.4C) than that of the surrounding copper free water. The interaction creates a new stimulus configuration which is different from those formed by the two variables separately. The orientation of the largemouth bass is not affected by copper ions at the concentrations tested. Channel catfish are weakly attracted by the copper-containing water and green sunfish significantly increase time spent there. Suckers significantly but not absolutely 'avoid' such water through changes in turning behavior.

17141. Colombo, Lorenzo, Howard A. Bern, Julie Pieprzyk and Donald W. Johnson (Dept. of Zool. and Its Cancer Res. Lab., Univ. of Calif., Berkeley, California). 1973. BIOSYNTHESIS OF 11-DEOXYCORTICOSTEROIDS BY TELEOST OVARIES AND DISCUSSION OF THEIR POSSIBLE ROLE IN OOCYTE MATURATION AND OVULATION. Gen. and Comp. Endocrinology, 21(1): 168-178.

Incubations of minced ovarian preparations of the teleost fish Leptocottus armatus, Gillichthys mirabilis, and Microgadus proximus yielded the following metabolites identifiable by their isopolarity and isomorphicity with standard compounds: 11-deoxycorticosterone, 17α-hydroxyprogesterone, androstenedione, and testosterone. In addition, 11-deoxycorticol was found in the incubates of the last two species. Integration of the product yield-time curves indicated that more 11-deoxycorticosteroids were synthesized by Gillichthys ovary than androgens; that the converse was true with Leptocottus; and that in Microgadus androgens and 11-deoxycorticosteroids were equally important. Preliminary evidence was also obtained of the formation of water-soluble metabolites by Microgadus ovary. Taking into account previous work by other authors, it is proposed that, in teleosts, ovarian 11-deoxycorticosterone and 11-deoxycortisol may act as local hormones mediating the pituitary gonadotropin-induced maturation and ovulation of oocytes. (Authors)

17142. Norling, Ingemar (Grad. School of Social Work and Public Admn., Gothenburg, Sweden). 1968. ECONOMIC EVALUATION OF INLAND SPORT FISHING. EIFAC Technical Paper No. 7, 96 p.

Part I of the present report describes the main problems, concepts, measures and methods for evaluating sport fishing. Definitions and objectives are discussed according to their importance. Very little research work in Europe has been or is being carried out on this subject. Part II is a compilation of abstracts and conclusions of relevant published and unpublished reports and articles on socio-economic aspects of sport fishing. Many of these were taken from the SFI Bulletin. (Auth.)

17143. Schwartz, Robert J., and Charles E. Wilde, Jr. (School of Dent. Med., Univ. pf Pennsylvania, Dept. of Histol. and Embryol, Philadelphia, Pennsylvania). 1973. CHANGES IN PROTEIN SYNTHESIS IN THE MORPHOGENESIS OF Fundulus heteroclitus. Nature, 245(5425): 376-379.

17144. Schneider, James C. 1973. RESPONSE OF THE BLUEGILL POPULATION AND FISHERY OF MILL LAKE TO INCREASED GROWTH: A SIMULATION MODEL. Mich. Dept. of Nat. Resources, Fish. Div., Fish. Res. Report No. 1805, 17 p.

The growth rate of the bluegill in Mill Lake was increased hypothetically from slow to average to fast. New populations were generated with the assumptions that (1) natural mortality is age dependent (Model A) and (2) natural mortality is size dependent (Model B). The populations were then subjected to "fishing" and changes in the size and structure of the population were noted. Catch from the populations was predicted also. Considering the large differences in growth, the differences in the populations and fisheries were small. According to the most realistic model (B), yield in kilograms and average size of bluegills creeled would increase with growth, and the numbers of large bluegills in the population would increase substantially if growth were increased from slow to fast. These benefits may be dampened considerably if the total standing crop of bluegills had to be reduced in order to improve growth. A similar model was constructed for the bluegill population and fishery of Sugarloaf Lake. The characteristics and predictions from that model agreed with empirical data from Sugarloaf Lake. (Auth.)

17145. Zyznar, E. S., and J. A. Nicol, F.R.S. (The Univ. of Texas Marine Sci. Inst., Port Aransas, Texas 78373). 1973. REFLECTING MATERIALS IN THE EYES OF THREE TELEOSTS, Orthopristes chrysopterus, Dorosoma cepedianum AND Anchoa mitchilli. Proc. R. Soc. Lond. B, 184(1074): 15-27.

The tapeta lucida of three species of teleosts were examined to determine the composition of the reflecting material. The fishes were bay anchovy Anchoa mitchilli (Engraulidae), gizzard shad Dorosoma cepedianum (Clupeidae) and pigfish Orthopristes chrysopterus (Haemulidae). The tapetum of each species was situated in the pigment epithelium of the eye. That of the pigfish contained triglycerides identified as chiefly glyceryl tridocosahexaenoate. A reduced pteridine, 7,8-dihydroxanthopterin, occurred in the tapetum of the gizzard shad. Guanine occurred in the tapetum of the bay anchovy. The tapetum of the shad contained brightly reflecting particles about 0.5 μm in diameter. There were 10.8 mg of dihydroxanthopterin in the tapetum of a shad (total body length 23 cm) and 0.46 mg of guanine in the tapetum of an anchovy (total body length 9 cm). This is the first report of a pteridine acting as a retinal reflector in vertebrates. Various aspects of retinal reflectors of teleosts are discussed and their variety and common characteristics commented upon. (Authors)

17146. Davy, F. B., and H. Kleerekoper, and J. H. Matis (Dept. of Biol., Texas A&M Univ., College Station, Texas 77843). 1973. EFFECTS OF EXPOSURE TO SUBLETHAL DDT ON THE EXPLORATORY BEHAVIOR OF GOLDFISH (Carassius auratus). Water Resources Research, 9(4): 900-905.

When they are introduced into a novel environment, normal goldfish display a highly specific, nonrandom exploratory behavior. It consists of a systematic spatial and temporal distribution of activity that in the light of its complexity is assumed to be under the control of the central nervous system. Aspects of this exploratory behavior are significantly affected by chronic exposure to DDT (10 μg/l p.p'. DDT for 4 days), and thus earlier suggestions in the literature that the pesticide may affect functions controlled by the central nervous system are reinforced. The maintenance of the fish for 20 hours in laboratory water following exposure to DDT resulted in a decrease in the described DDT effect. (Authors)

17147. Fletcher, G. L. (Fish. Res. Bd. Canada, Halifax Lab. and Mar. Sci. Res. Lab., Memorial Univ. of Newfoundland, St. John's, Newfoundland, Canada). 1973. THE ACUTE TOXICITY OF A YELLOW PHOSPHORUS CONTAMINATED DIET TO BROOK TROUT. Bull. Environ. Contamination and Toxicology, 10(2): 123-128.

Yellow phosphorus (P_4) contaminated cod muscle (P_4, 4-11 μg/g) and liver (P_4, 194 μg/g) were lethal when fed to brook trout. The symptoms of P_4 poisoning were identical to those observed when this element is present in water, namely, external redness, hemolysis and reduced hematocrits. The approximate toxic dosage of P_4 ranged from 1.23-2.73 mg. (Auth.'s summ.)

17148. Bond, W. A., T. D. Turnbull (Lake Mgmt. Section, Resource Mgmt. Branch, Environment Canada, Central Region, Canada). 1973. FISHERY INVESTIGATIONS AT GREAT SLAVE LAKE, N.W.T. 1972. Technical Report Series No. CEN/T-73-7, Environment Canada, 78 p.

The Great Slave Lake commercial fishery was studied during summer, 1972. Measurements were made on 6435 commercially caught whitefish. Age determinations, on 2085 of these whitefish showed the mean age to be 10.5 years with four age groups (9-12 incl.) making up 77% of the sample. The annual mortality rate was 0.58. The mean weight of whitefish has not changed since 1964. Test net results indicate that the relative abundance of the various fish species has changed considerably since exploitation began. The major cause of this change has been the virtual elimination of the lake trout from the western part of the lake. There are indications that this process of elimination is progressing eastward. The effects of exploitation on the whitefish populations have been more pronounced in the extreme western portion of the lake. These effects include an increase in the rate of growth, a reduction in the age of maturity and an alteration of the sex ratio in favour of males. Great Slave Lake whitefish do not become fully susceptible to commercial gear until they have reached a fork length of about 400 mm. (Authors)

17149. Pentreath, R. J. (Fish. Radiobiol. Lab., Lowestoft, Suffolk, England). 1973. THE ACCUMULATION AND RETENTION OF ^{65}Zn AND ^{54}Mn BY THE PLAICE, Pleuronectes platessa L. J. exp. mar. Biol. Ecol., 12(1): 1-18.

Studies of the uptake and loss of ^{65}Zn and ^{54}Mn by plaice, Pleuronectes platessa L., have shown that direct accumulation from water plays only a minor role relative to food in the metabolism of these metals. Accumulation of both isotopes from water was followed at tissue level and their levels of accumulation were related to stable element concentrations. Biological half-times were also calculated for accumulation and loss to water, for loss of activity following an intraperitoneal injection and, using calculations of feeding rate and assimilation of the isotopes, from food. Some comparative studies were carried out with fed and starved fish. In view of the relatively minor role of direct accumulation from water it was considered that the concentrations of these metals would decrease at this level of the marine food chain. The relevance of such observations to toxicity testing is also discussed. (Auth.)

17150. Hughes, Robert A., and G. Fred Lee (Univ. of Wisconsin, Madison, Wis. 53706). 1973. TOXAPHENE ACCUMULATION IN FISH IN LAKES TREATED FOR ROUGH FISH CONTROL. Environmental Science and Technology, 7(10): 934-939.

The addition of toxaphene to several Wisconsin lakes for fish management purposes provided an opportunity to study some aspects of the persistence of toxaphene in aquatic communities. After toxaphene was added to three shallow, hard-water, nutrient-rich Wisconsin lakes to destroy stunted or rough fish populations, concentrations of the chemical remaining in the water and plankton were monitored until residue levels became nondeterminable. Bluegills accumulated residue toxaphene concentrations of nearly 10 μg/g and reproduced successfully. Toxaphene and toxaphene residue accumulation were more closely related to fat content of fish than to fish weight. Edible flesh of bluegills contained less than 10% of the whole body burden of toxaphene residues, and as much as 27% of the residues in this tissue was removed by pan frying.

17151. Garside, E. T. (Dept. of Biol., Dalhousie Univ., Halifax, Nova Scotia, Canada). 1973. ULTIMATE UPPER LETHAL TEMPERATURE OF ATLANTIC SALMON Salmo salar L. Canad. J. Zool., 51(8): 898-900.

Parr (70-147 mm) of Atlantic salmon Salmo salar L. from Big Brook, Terra Nova National Park, Newfoundland, were progressively acclimated to 27.5 C in fresh water of the home stream, and the upper lethal temperature was determined by probit analysis to be 27.80 C $\pm$ 0.41. This is essentially the ultimate upper lethal temperature. (Auth.)

17152. Sills, Joe B., John L. Allen, Paul D. Harman, and Charles W. Luhning (Fish Control Labs, La Crosse, Wisconsin). 1973. RESIDUE OF QUINALDINE IN TEN SPECIES OF FISH FOLLOWING ANESTHESIA WITH QUINALDINE SULFATE. U. S. Dept. of the Interior, Investigations in Fish Control No. 50, 9 p.

The concentration and persistence of residues of the anesthetic quinaldine in five species of both coldwater and warmwater fishes were measured following treatment with the new formulation quinaldine sulfate. Quinaldine accumulated in relation to increasing temperature, treatment concentration, and length of exposure. Mean concentrations of quinaldine residues ranged from 1.18 to 8.31 μg/g for the 0-hour withdrawal time. Initial residues were higher in warmwater species than in salmonids. Although a wide range of residue concentrations (0.80-9.34 μg/g) occurred immediately after exposure, these residues are dissipated rapidly when the fish are placed in fresh water. All fish tested after 24 hours of withdrawal in fresh water contained 0.01 μg/g or less of quinaldine residue with the exception of the rainbow trout treated at 7°C. (Authors)

17153. Moyle, Peter B., and Robert D. Nichols (Dept. of An. Physiol., Univ. of Calif., Davis, California). 1973. ECOLOGY OF SOME NATIVE AND INTRODUCED FISHES OF THE SIERRA NEVADA FOOTHILLS IN CENTRAL CALIFORNIA. Copeia, No. 3, pp. 478-490.

Collections were made of fishes occurring in the streams of the Sierra Nevada foothills in Central California. Environmental factors associated with each collection were recorded. Correlation analyses indicated which environmental factors affected the distribution of 11 of the 21 species collected: Micropterus salmoides, Lepomis cyanellus, L. macrochirus, Gambusia affinis, Notemigonus crysoleucas, Lavinia exilicauda, Ptychocheilus grandis, Mylopharodon conocephalus, Hesperoleucus symmetricus, Catostomus occidentalis and Salmo gairdneri. The fishes were found to belong to four distinct fish associations, each found in a distinctive set of environmental conditions. The Rainbow Trout Association was found in the cold, clear permanent streams of the higher elevations. The California Roach Association was found in the small, warm intermittent tributaries to the larger streams. The Native Cyprinid-Catostomid Association was found in the larger low elevation streams. The Introduced Fishes Association was found in low elevation intermittent streams that had been highly modified by man's activities. (Authors)

17154. von Geldern, C. E., Jr., and Patrick K. Tomlinson. 1973. ON THE ANALYSIS OF ANGLER CATCH RATE DATA FROM WARMWATER RESERVOIRS. Calif. Fish and Game, 59(4): 281-292.

A method for estimating angling quality on large warmwater impoundments with multiple access points is described. The plan features a roving census clerk who contacts anglers while they are actively fishing. Consideration is given to the selection of a catch rate estimator and a procedure for calculating the associated variance is described. Computer output utilizing data descriptive of the bluegill segment of the Lake Nacimiento, California, fishery is used to illustrate this census procedure. (Authors)

17155. Vestergård Jørgensen, P. E. (State Vet. Serum Lab., Dept. for Jutland, Arhus, Denmark). 1973. THE NATURE AND BIOLOGICAL ACTIVITY OF IPN VIRUS NEUTRALIZING ANTIBODIES IN NORMAL AND IMMUNIZED RAINBOW TROUT (Salmo gairdneri). Archiv für die gesamte Virusforschung, 42: 9-20; Fish Health News, 2(4): p. 11.

By means of the plaque-reduction technique high titres of neutralizing antibodies to IPN virus were demonstrated in serum from rainbow trout reared in apparently IPN-free environments as well as from trout exposed to the virus through natural or artificial infection. The neutralizing antibodies were in all cases found to be sensitive to incomplete reduction and alkylation. When trout sera were subjected to gel filtration on Sepharose 4 B high titres of neutralizing antibodies were found in fractions from the first protein peak, which contained a protein of β-2 (macroglobulin) mobility. The production of a monovalent rabbit antiserum to trout immunoglobulin is described. (Auth.'s summ.)

17156. Peterka, J. J. (Dept. of Zool., North Dakota State Univ., Fargo, North Dakota). 1972. EFFECTS OF SALINE WATERS UPON SURVIVAL OF FISH EGGS AND LARVAE AND UPON THE ECOLOGY OF THE FATHEAD MINNOW IN NORTH DAKOTA. North Dakota Water Resources Research Inst., Fargo, Completion Report WI-221-013-72, 11 p.; Selected Water Resources Abstracts, 6(22): p. 49.

Because North Dakota saline pothole lakes offer a good potential for fish culture and the anticipation of increased salinity from return flows from the Garrison Diversion Irrigation Project, salinity tolerance of the fathead minnow, northern pike, and walleye were evaluated. Also studied was the influence of the levels of dissolved solids on egg and sac fry survival and the fathead minnow's food habits. Laboratory experiments indicated that in water of 1300 micromhos, eggs of fathead minnow, northern pike and walleye hatched well, but when salinity reached 4000 micromhos, there was no hatching of walleye, a very poor hatch of northern pike eggs, but a good hatch of fathead minnow eggs. No northern pike sac fry survived in water of 6000 micromhos and all fathead minnow sac fry (about 1%) surviving in 12,000 micromhos had physical abnormalities. Water in saline lakes with an early summer total dissolved solid concentration of 7000 ppm was not detrimental to fathead minnow reproduction and growth. Fathead minnows consume food similar to several duck species inhabiting the pothole lakes.

17157. Congdon, James C. (Dept. of Nat. Resources, Box D, Horicon, Wisconsin 53032). 1973. FISH POPULATIONS OF CHANNELIZED AND UNCHANNELIZED SECTIONS OF THE CHARITON RIVER, MISSOURI. N. C. Div. Amer. Fish. Soc. Spec. Pub. No. 2, pp. 52-62.

Nearly 100% of the 1,842 miles of major streams in Missouri north of the Missouri River have been channelized or are threatened with channelization or inundation by flood control reservoirs. The objective of this study was to determine fisheries losses resulting from stream channelization. Mark and recapture population estimates using electrofishing gear and rotenone were made to determine standing crops and species composition of fish populations in channelized and unchannelized sections of the Chariton River, Missouri. In the unchannelized section 21 species of fish were found compared to 13 species in the channelized section. The standing crop of fish in the unchannelized section was estimated to be 304 pounds per acre compared to 53 pounds per acre in the channelized section, a 83 percent reduction. In the unchannelized section carp (152 pounds per acre), river carpsuckers (77 pounds per acre), and channel catfish (44 pounds per acre) were the dominant species. In the channelized section channel catfish (31 pounds per acre), river carpsuckers (14 pounds per acre), and carp (5 pounds per acre) were the dominant species. The standing crop of catchable-size fish in the unchannelized section was estimated to be 187 pounds per acre compared to 27 pounds per acre in the channelized section, a 86 percent reduction. There were six species of catchable-size fish in the unchannelized section compared to four in the channelized section. Channel straightening resulted in the loss of 103 miles of river, or a 55.2 percent reduction in stream length. The combined effects of a poorer environment and reduced stream length resulted in an estimated 87.0 percent reduction in total standing crop in the studied channelized section. The standing crop of catchable-size fish was reduced by 89 percent. (Auth.)

17158. Wilson, Robert P. (Dept. of Biochem., Mississippi State Univ., State College, Mississippi). 1973. NITROGEN METABOLISM IN CHANNEL CATFISH Ictalurus punctatus - I. TISSUE DISTRIBUTION OF ASPARTATE AND ALANINE AMINOTRANSFERASES AND GLUTAMIC DEHYDROGENASE. Comp. Biochem. and Physiol, 46(3B): 617-624.

The activities of aspartate (AspT) and alanine (AIT) aminotransferases and glutamic dehydrogenase (GDH) were measured in various tissue homogenates of cultured and native channel catfish. AspT and AIT were detected in liver, kidney, gill, gut tract, heart, spleen and brain tissue. GDH was detected in all of the above tissues except brain. Significant differences occurred in all three enzymes in certain tissues with values in the cultured fish being somewhat higher than those obtained in the native fish. These differences may be due to differences in the diets of the two groups of fish. (Auth.)

17159. Ogino, Chinkichi, Jun Kakino, and Mao-Song Chen (Lab. Fish. Biochem., Tokyo Univ. of Fish., Konan 4, Minato-ku, Tokyo, Japan). 1973. PROTEIN NUTRITION IN FISH - II. DETERMINATION OF METABOLIC FECAL NITROGEN AND ENDOGENOUS NITROGEN EXCRETIONS OF CARP. Bull. Jap. Soc. Sci. Fish., 39(5): 519-523. In Japanese with English abstract.

An apparatus was newly devised to catch the nitrogen excreted in the feces and urine of fish. It consists mainly of three parts, namely, a culture tank for maintenance of fish, a test tube containing chloroform as a fecal N preservative and cupric hydroxide as a protein precipitant, and a column of strongly acidic resin for adsorbing dissolved urinary nitrogen. The test tube is connected to the tank by a siphon and the outlet of the test tube is attached to the resin column. The water, supplied continuously at a slow rate to the tank, first enters the test tube through a siphon and then the column of resin, leaving feces in the test tube. By using this apparatus the metabolic fecal N and endogenous N excretions of carp were determined. These nitrogen fractions excreted by carp were shown to fluctuate depending on experimental temperatures.

17160. Parker, Jack C. (Texas A&M Univ., College Station, Texas). 1973. LENGTH-WEIGHT RELATIONSHIP AND CONDITION OF Leiostomus xanthurus Lacépède, AND Micropogon undulatus (Linnaeus) IN GALVESTON BAY, TEXAS. The Southwestern Naturalist, 18(2): 211-227.

Length-weight data on juvenile spot, Leiostomus xanthurus Lacépède, and Atlantic croaker, Micropogon undulatus (Linnaeus), taken in Galveston Bay, Texas during 1963, were used to examine variations in condition of fish between nursery areas within the bay and with size of fish, time, temperature and salinity. Changes in the condition of spot were associated with habitat, size, season, and temperature and in the condition of Atlantic croaker with size, season, and salinity. Because these fish were immature, gonad development was discounted as a causative factor, and it was concluded that changes in condition represented changes in body form associated with growth and fatness that are in turn associated with suitability of the environment. (Auth.)

17161. Rommel, Sentiel A., Jr., and James D. McCleave (Dept. of Zool., Univ. of Maine, Orono, Maine). 1973. PREDICTION OF OCEANIC ELECTRIC FIELDS IN RELATION TO FISH MIGRATION. J. Cons. int. Explor. Mer, 35(1): 27-31.

Several hypotheses exist in the literature suggesting the use of oceanic geoelectric fields in fish orientation, but only surface electric field values are readily available. However fishes may migrate at considerable depths. Standard electrical circuit analysis techniques were utilized to develop a two-dimensional predictive model for the geoelectric fields in ocean current systems. In six cross sections of the Gulf Stream examined as examples, total electric field intensities up to 0.46 μV/cm and current densities up to 0.0175 $\mu A/cm^2$ were predicted. The electro-sensitivity of the American eel and the Atlantic salmon are within this range. Thus sufficient information is available for possible electro-orientation of at least two migratory fishes. (Authors)

17162. Rodriguez, L. V., and R. A. Flickinger (Dept. of Biol., State Univ. of New York, Buffalo, New York). 1973. EFFECT OF TEMPERATURE UPON CELL DIVISION, RNA AND PROTEIN SYNTHESIS OF CULTURED FATHEAD MINNOW CELLS. Comp. Biochem. and Physiol., 46(2A): 279-290.

Cells of the fathead minnow cultured at 34°C grow about nine times as rapidly as at 14°C; each cell at 34°C has one-half as much total and ribosomal RNA, twice as much protein per cell and more polysomes than at 14°C. Double labeling with 3H-methylmethionine and 2-^{14}C-uridine suggests DNA-like RNA is a constant fraction of the newly synthesized RNA at 14 and 34°C. DNA-RNA hybridization studies with nuclear and whole cell RNA show that cells at 34°C accumulate more kinds of DNA-like RNA than at 14°C. Cells at 34°C spend a greater percentage of their generation time in the "S" period of the cell cycle than do cells at 14°C. (Authors)

17163. European Inland Fisheries Advisory Commission (Working Party on Water Quality Criteria for European Freshwater Fish, FAO, Rome, Italy). 1972. REPORT ON MONOHYDRIC PHENOLS AND INLAND FISHERIES. EIFAC Technical Paper No. 15, 18 p.

Phenolic wastes can contain monohydric phenols, including phenol, the three cresol isomers, and the six xylenol isomers, together with other substances. Laboratory tests show that the toxicity of phenol is increased by decrease in dissolved oxygen concentration, increase in salinity, and decrease in temperature. To ensure long-term survival of salmonids in the presence of phenolic wastes, the concentration of phenol, cresols or xylenols should not exceed 1.0 mg/l, either singly or collectively. Since laboratory data show that coarse fish are more resistant than salmonids to phenols, the concentration of phenol, cresol or xylenol should not exceed 2.0 mg/l, either singly or collectively, provided that oxidation of this concentration does not produce an adverse reduction in the dissolved-oxygen concentration of the water. Where other poisons are present in addition to phenols due allowance must be made for their contribution to the toxicity, particularly in the case of free chlorine. There is no laboratory evidence to indicate that levels of phenol and cresols that are safe for fish cause their flesh to become tainted, but xylenols should not exceed 0.5 mg/l. (From Authors' summ.)

17164. Allen, Donald M., William N. McFarland, Frederick W. Munz, and Hugh A. Poston (Dept. of Zool., Univ. of Michigan, Ann Arbor, Michigan). 1973. CHANGES IN THE VISUAL PIGMENTS OF TROUT. Canad. J. Zool., 51(9): 901-914.

The proportions of two visual pigments (rhodopsin and porphyropsin) were examined in four species of trout under experimental and natural conditions. Brook trout (Salvelinus fontinalis), rainbow trout (Salmo gairdneri), and brown trout (Salmo trutta) have different relative proportions of visual pigments in their retinae. The visual pigment balance in wild cutthroat trout (Salmo clarki) is related to forest canopy (access to light) and season. The brown trout have a more red-sensitive and less labile pair of visual pigments than brook or rainbow trout, which respond to photic conditions by increasing the proportion of porphyropsin (in light) and increasing rhodopsin (in darkness). The brown trout have a high percentage of porphyropsin, regardless of experimental conditions. This result does not reflect an inability to form rhodopsin but rather may relate to a consistently high proportion of 3-dehydroretinol in the pigment epithelium. The possible advantages and mechanisms of environmental control of trout visual pigment absorbance, as currently understood, are discussed. (Authors)

17165. Nagai, Masanori, and Shizunori Ikeda (Dept. of Fish., Fac. of Agric., Kyoto Univ., Kyoto, Japan). 1973. CARBOHYDRATE METABOLISM IN FISH - IV. EFFECT OF DIETARY COMPOSITION ON METABOLISM OF ACETATE-U-^{14}C AND L-ALANINE-U-^{14}C IN CARP. Bull. Jap. Soc. Sci. Fish., 39(6): 633-643. In English.

The metabolism of acetate-U-^{14}C and L-alanine-U-^{14}C in carp was investigated. On feeding a high carbohydrate diet, incorporation of radioactive carbon from these labeled compounds into hepatopancreatic lipid was decreased, whereas $^{14}CO_2$ evolution was increased. The condensing enzyme activity was also depressed. The reverse of these phenomena was observed on feeding a high protein diet. Gluconeogenesis appeared to proceed more from ^{14}C-alanine than from ^{14}C-acetate. GPT and GOT activities were almost equal, regardless of dietary conditions. However, G6Pase activity increased with an increase in dietary protein. The results obtained suggest that the glycolytic activity of carp is not contributive enough to synthesize lipid. The precursor for lipogenesis seems to be citrate formed when amino acids are actively metabolized through the TCA cycle. The energy-utilization form of normal carp seems to resemble that of diabetic animals. Possible relationships between carbohydrate, protein and lipid metabolism and the inferiority of carbohydrate as an energy source in carp are discussed.

17166. Fleener, George G. (Missouri Dept. of Conservation, Fish and Game Research Center, 1110 College Ave., Columbia, Missouri 65201). 1973. RECREATIONAL USE OF THE PLATTE RIVER, MISSOURI. N. C. Div. Amer. Fish. Soc. Spec. Pub. No. 2, pp. 63-78.

Of the 138 miles of the Platte River in Missouri, the upper 73 miles has been channelized. A project authorized in 1965 calls for 41.2 miles of channel realignment from the mouth to the vicinity of Agency. The proposed drainage district contains 15,361 acres. A one-year study of the total recreational use of the unchannelized portion was completed in August, 1971. The study area covered 57 miles of stream (602.5 acres) plus a small part of the river valley. A probability sampling method was used which gave good statistical precision. Thirteen 2-week periods were sampled in the year and results were expanded to give annual use. Details of the method are included. About 96,500 trips totalling over 348,000 hr. were expended by recreationists on the river and in an area about 100 ft. wide on each side. This is a conservative estimate since some access to the river was over private land, and the full width of the valley was not sampled. Fishing by pole and line and by set lines accounted for 49,500 trips, or 51% of the total trips. About 36,000 fish were harvested, of which 19,500 were channel and flathead catfish. Fishing pressure was 420 hr. per acre. By way of comparison, angling pressure ranged from 15 to 42 hr. per acre from 1959 to 1960 on Current River, a renowned Ozark stream. There were 10,580 trips by people engaged in 11 types of hunting activities. The estimated harvest included 31 deer, 950 doves, 1,368 rabbits, 9,091 quail, 532 ducks, 384 coyotes, and 252 frogs. Eight other miscellaneous activities accounted for 36,500 trips. Sightseeing accounted for 21,800 trips, picnicking 6,500 and camping 2,100. Other uses included nature study, boating, target shooting, and gathering products. More than 98% of the recreational users of Platte River were from Missouri. About two-thirds traveled 25 mi. or less, another 31% traveled 26 to 50 mi. Uses not related to fishing and hunting made up 38% of the total trips, and the needs of this group of recreationists should be of concern to resource agencies. There was no measurable increase in use during the year at access sites newly developed by the Department of Conservation but one formerly established access site was frequently used by recreationists. The heavy use of the Platte River by recreationists is due to its proximity to Kansas City and St. Joseph, Missouri. Channelization of Platte River would cause irreparable loss to outdoor recreationists in northwestern Missouri. (Auth.)

17167. Everhart, W. H., and R. A. Freeman (Dept. of Fish. and Wildl. Biology, Colo. State Univ., Fort Collins, Colorado). 1973. EFFECTS OF CHEMICAL VARIATIONS IN AQUATIC ENVIRONMENTS: VOLUME II, TOXIC EFFECTS OF AQUEOUS ALUMINUM TO RAINBOW TROUT. Environmental Protection Agency, Ecological Research Series Report No. EPA-R3-73-011b, 41 p.; Selected Water Resources Abstracts, 6(18): p. 67.

Fertilized eggs, fry and fingerlings were exposed to aqueous aluminum complexes in neutral and basic media under constantly flowing, controlled conditions of aluminum concentration, pH, and temperature. Toxicities of various concentrations were highly pH dependent. Dissolved concentrations over 1.5 ppm aluminum caused physiological and behavioral aberrations as well as acute mortality. Toxic effects of suspended aluminum, though greater at lower concentrations, do not increase as much as the effects of dissolved aluminum with higher concentrations. Growth of trout exposed to high dosages of aluminum was reduced only as long as or slightly longer than the exposure continued. Egg and fry bioassays were conducted with exposures in trays and simulated natural redds. Fertilization was not affected by any concentrations tested, and most mortalities occurred during hatching and in the post-swim-up stage. Trends in toxicity were similar to those found with fingerlings indicating dissolved aluminum to be more toxic than equivalent suspended amounts.

17168. Palmieri, James R. (Dept. of Zool. and Entomol., Iowa State Univ., Ames, Iowa). 1973. ADDITIONAL NATURAL AND EXPERIMENTAL HOSTS AND INTRASPECIFIC VARIATION IN Posthodiplostomum minimum (TREMATODA: DIPLOSTOMATIDAE). J. Parasit., 59(4): 744-746.

17169. Olson, Kenneth R., Harold L. Bergman, and Paul O. Fromm (Dept. of Physiol., Mich. State Univ., East Lansing, Michigan 48823). 1973. UPTAKE OF METHYL MERCURIC CHLORIDE BY TROUT: A STUDY OF UPTAKE PATHWAYS INTO THE WHOLE ANIMAL AND UPTAKE BY ERYTHROCYTES in vitro. J. Fish. Res. Bd Canada, 30(9): 1293-1299.

Twenty-four hour uptake rate of either $^{203}HgCl_2$ or $CH_3{}^{203}HgCl$ by rainbow trout (Salmo gairdneri) was not affected by esophageal ligation. Uptake of these two mercurials in nonfeeding trout appears to be by way of the gills. Methyl mercury enters the fish at a faster rate than the inorganic form and anomalous tissue distribution of these two mercurials suggests that inorganic mercury does not require methylation prior to entry into the fish. In vitro experiments using radioactive mercurials demonstrated high affinity of methyl mercury for red cells (up to 90% was bound to red cells in 40 min). Only 9% of inorganic mercury was taken up by red cells, but, this percentage was increased up to 65% if the cells were washed and suspended in Ringer solution prior to incubation with mercury. (Authors)

17170. Gard, Richard (NMFS, Auke Bay Fish. Lab., Auke Bay, Alaska 99821). 1973. TRAVEL TIME AND INFLUENCING FACTORS FOR MIGRATING ADULT SOCKEYE SALMON IN KARLUK RIVER, ALASKA. Trans. Amer. Fish. Soc., 102(4): 723-727.

Travel time of adult sockeye salmon (Oncorhynchus nerka) through the Karluk River, Alaska, was determined from fish tagged with Petersen disks about 2 miles (3 km) inside the river mouth and timed as they reached a weir at Karluk Lake, 21 miles (34 km) upstream. Migration time to the weir averaged 7 days for spring run and 10 days for fall run fish. The influence of three factors on travel time was determined by multiple regression analysis. Most important was time of season, followed by number of fish and rainfall. (Auth.)

17171. Filatov, V. I. (All-Union Pond Fish. Res. Inst. (VNIIPRKh), Settlement of Rybnyy, Dmitrov, Moscow Province, USSR). 1972. EFFECTIVENESS OF THE UTILIZATION OF NATURAL FOODS BY CARP [Cyprinus carpio (L.)] LARVAE. J. Ichthyol., 12(5): 812-818.

Information is given on the feeding of carp larvae on plankton [Brachyonus calyciflorus (Pallas), Chydorus sphaericus (Müller), Ceriodaphnia reticulata (Jurine) and Moina rectirostris (Leydig)] from the time of their transition to exogenous feeding. These indicators are shown to be dependent on the species of plankton organism, its concentration and water temperature. Information is given on the utilization of these kinds of food by carp larvae for growth. The choice of species of plankton organisms was made on the basis of an analysis of the food of larvae taken from growth ponds. The energy balance of larvae weighing 1-5 mg feeding on the foods referred to above has been calculated on the basis of experimental data.

17172. Coutant, C. C. (Pacific Northwest Labs., Battelle Memorial Inst., Richland, Washington). 1972. EFFECT OF THERMAL SHOCK ON VULNERABILITY TO PREDATION IN JUVENILE SALMONIDS. II. A DOSE RESPONSE BY RAINBOW TROUT TO THREE SHOCK TEMPERATURES. Report No. UC-48, Nov. 1972, 12 p., available from the NTIS as BNWL-1519, $3.00 paper copy, $1.45 microfiche; Selected Water Resources Abstracts, 6(21): p. 76.

Juvenile rainbow trout (Salmo gairdneri) were found to be more vulnerable to predation following thermal shock, dependent on the thermal dose (temperature and duration) received. The fish were exposed to temperatures of 26, 28, and 30C for periods from 0.5 to 100 minutes. Control fish were exposed to unheated water. Control and shocked fish were then reunited at the acclimation temperature and offered to adult rainbow trout predators. The predators were allowed a maximum of 15 minutes to remove about 50 percent of the prey and the remaining test and control fish were counted. A chi-square analysis was used on the results. At 30C exposure, an identifiable effect in vulnerability of the shocked fish occurred after only 0.55 min exposure. At 28C, an exposure of about 2 min was needed to increase vulnerability. The 26C exposure temperature, included significantly different predation rates after 64 min but not after 16 or 32 min. -- Mortland-Battelle)

17173. Born, Stephen, Thomas L. Wirth, James O. Peterson, J. Peter Wall and David A. Stephenson. 1973. DILUTIONAL PUMPING AT SNAKE LAKE, WISCONSIN. A POTENTIAL RENEWAL TECHNIQUE FOR SMALL EUTROPHIC LAKES. Dept. of Natural Resources, Madison, Wis., Technical Bull. No. 66, 32 p.

Snake Lake, a 12.3-acre (5.0 ha), colored, soft-water lake in northern Wisconsin, received the direct discharge of municipal wastes for more than twenty years. Consequent accelerated eutrophication destroyed the recreational and aesthetic values of Snake Lake; annual dissolved oxygen depletion and nuisance aquatic plant growth have converted a community asset to a liability. Rehabilitation of Snake Lake was attempted by employing a lake flushing scheme by means of dilutional pumping. The local geology and hydrology suggested an innovative flushing method in which nutrient-rich lake water was pumped from the lake to a nearby land disposal area, allowing dilution by influent ground waters. Lake water quality parameters were measured for more than three years during the study. Soil, hydrogeologic (particularly lake - ground water relationships), and bottom sediment nutrient transfer studies were also conducted in conjunction with the lake renewal activity. Preliminary pumping was conducted for a two-week period in October 1969 in order to test equipment, evaluate water disposal area operations, and assess the response of the hydrogeologic system to stress (pumping). About two-thirds of a lake volume was pumped during this preliminary activity. During July-August 1970, the main dilutional pumping effort took place; about three lake volumes were pumped from Snake Lake and lake level declined about 11 feet (3.4 m). Dilutional pumping of Snake Lake has not "renewed" the lake; severe dissolved oxygen depletion problems during two winters following pumping continue to prevent the establishment of a sport fishery. However, the 1969-1971 dilutional pumping experiment has shown that flushing of a lake can result in substantial nutrient reduction. At Snake Lake, phosphorus concentrations were diluted and have remained significantly lower than before pumping (although total phosphorus levels are still relatively high). Nitrogen and chloride levels, conductance, and color were also reduced as a result of dilutional pumping; however, these changes were of a short-term nature, and by the following year these parameters had returned to former levels. Other effects of dilutional pumping included the elimination of nuisance blooms of duckweed and deepening of littoral areas due to subsidence associated with dewatering. Bottom sediments appear to be the major source of regenerated nutrients. (Authors)

17174. Uchida, Naoyuki, Takeshi Obata, and Tsuneyuki Saito (Lab. of Biochem., Fac. of Fish., Hokkaido Univ., Hakodate, Japan). 1973. OCCURRENCE OF INACTIVE PRECURSORS OF PROTEASES IN CHUM SALMON PYLORIC CAECA. Bull. Jap. Soc. Sci. Fish., 39(7): 825-828. In Japanese with English abstract.

The extraction of inactive precursors of proteases from pyloric caeca of chum salmon, Oncorhynchus keta, was examined. Crude extract was obtained by homogenizing the acetone powder of pyloric caeca in phosphate buffer, pH 8.0 (containing 0.5 mg of soybean trypsin inhibitor/ml and 1 mM DFP). Trypsin and chymotrypsin activities were present slightly in the extract. These activities did not increase even after incubation at 10°C and pH 8.0. On the other hand, when the extract containing bovine trypsin as an activator was incubated at 10°C and pH 8.0, trypsin and chymotrypsin activities increased rapidly. Considerable carboxypeptidase A and B activities were originally observed in this extract, but these activities did not change on incubation at 10°C and pH 8.0. On addition of bovine trypsin to the extract, these activities increased rapidly. From these results, it was concluded that trypsin, chymotrypsin and carboxypeptidase A and B of pyloric caeca of chum salmon were present in the gland and in the exocrine juice as inactive precursors or zymogens and that these inactive precursors are extractable by the method described.

17175. Zitko, V., and P. M. K. Choi (Fish. Res. Bd. of Canada, Biol. Sta., St. Andrews, New Brunswick, Canada). 1973. ORAL TOXICITY OF CHLORINATED DIBENZOFURANS TO JUVENILE ATLANTIC SALMON. Bull. of Environmental Contamination & Toxicology, 10(2): 120-122.

The data presented indicate that in fish, as well as mammals, chlorinated dibenzofurans are much more toxic than PCB. Nothing is known about the input and possible formation of chlorinated dibenzofurans in the environment.

17176. Allen, Richard L., and Thomas K. Meekin (Dept. of Fish., Mgmt. and Res. Div., State of Washington). 1973. AN EVALUATION OF THE PRIEST RAPIDS CHINOOK SALMON SPAWNING CHANNEL, 1963-1971. Wash. Dept. of Fisheries Technical Report No. 11, 52 p.

The Priest Rapids Spawning Channel was completed in 1963 as a mitigative facility for loss of chinook salmon, Oncorhynchus tshawytscha (Walbaum), spawning grounds resulting from the construction of Priest Rapids and Wanapum Dams on the Columbia River. The 6,000-ft long spawning channel was designed to accommodate 2,500 pairs of chinook. The channel was initially plagued with serious adult pre-spawning mortalities, delayed spawning activity of many adults, disease afflictions of both adults and juveniles, and overall poor downstream migrant productions. Most of the problems were resolved by 1967 and high production rates were realized for the 1967, 1968, and 1969 broods. Some delayed adult spawning activity re-occurred in 1969 and production of the 1970 brood was damaged by wind-blown sediment deposits, a continuing problem caused by the physical terrain of the Priest Rapids area. Another major unresolved problem is the lack of significant adult returns to the facility. This situation is apparently due to the poor seaward survival rate of the juveniles plus a high straying rate for returning adults, and its solution may necessitate a major change in the "natural" rearing concept of the channel. (Authors)

17177. Van Cleve, Richard, and Donald E. Bevan (Coll. of Fish., Univ. of Wash., Seattle, Washington 98195). 1973. EVALUATION OF CAUSES FOR THE DECLINE OF THE KARLUK SOCKEYE SALMON RUNS AND RECOMMENDATIONS FOR REHABILITATION. U. S. Dept. of Comm., NOAA Fishery Bull., 71(3): 627-649.

The continued decline of the Karluk River sockeye salmon, Oncorhynchus nerka, runs indicated the need for review of their condition. We reviewed the literature on the Karluk sockeye salmon and the different explanations for their decline. Unpublished material from the Auke Bay Fisheries Laboratory, National Marine Fisheries Service, was studied along with published and unpublished observations of Karluk sockeye salmon by the Fisheries Research Institute. Recent reports showing the behavioral differences between fry from one of the side streams and from the Karluk River, combined with studies of the genetic basis of similar behavioral differences in Fraser River sockeye salmon populations indicate that the sockeye salmon of the Karluk system are separated into a number of different races. The spawner-recruit relationship was examined over the 50 yr during which the numbers of spawners and resulting returns have been estimated. The combination of all evidence including peculiarities of sockeye salmon life history, derived from the work of the International Pacific Salmon Fisheries Commission on the Fraser River, and from the material on the Karluk, leads to the conclusion that the Karluk River below Karluk Lake is the largest and most productive spawning area in the system. We conclude that the productivity of the races spawning on these grounds could be restored by removal of all weirs from the Karluk system, by restricting the study of these fish in freshwater to methods which do not involve interfering in any way with the free movement of adults or young, and by protecting the adult Karluk sockeye salmon that move through the fishery in midseason, i.e., during July and August each year. (Authors)

17178. Roberts, Ronald J., A. McQueen, W. M. Shearer, and H. Young (Aquatic Pathobiol. Unit, Univ. of Stirling, Scotland). 1973. THE HISTOPATHOLOGY OF SALMON TAGGING II. THE CHRONIC TAGGING LESION IN RETURNING ADULT FISH. J. Fish Biol., 5(5): 615-619.

The process of tagging large numbers of juvenile salmon Salmo salar (L.) to enable studies of their migratory pathways, is now well established. A description of the usual method used in Scotland and the immediate pathological effects of the tagging trauma on the young salmon are contained in a previous paper. The purpose of the present study was to delineate the long-term changes which are apparent in the tag wound at the end of the one or two year period which the majority of salmon spend at sea prior to their return to the native river to spawn. (Authors)

17179. Emerson, S., and R. Hesslein (Lamont-Doherty Geological Observatory of Columbia Univ., Palisades, New York 10964). 1973. DISTRIBUTION AND UPTAKE OF ARTIFICIALLY INTRODUCED RADIUM-226 IN A SMALL LAKE. J. Fish. Res. Bd. Canada, 30(10): 1485-1490.

Radium-226 was added to lake 227 of the Experimental Lakes Area in August 1970 so that gas-exchange rates between the atmosphere and the lake could be traced by its gaseous daughter product radon-222. Although we expected the radium to remain in solution it did so for only about 1 month. An investigation to locate the radium after it left solution revealed that it was taken up on the bottom in the littoral zone. Further experiments indicated that it had adsorbed to the algal detrital material on the littoral sediment surface. Seasonal movement of this material could thus be monitored by following the movement of the radium with time. (Authors)

17180. FAO of the United Nations (Rome, Italy). 1973. FAO AQUACULTURE BULLETIN. A QUARTERLY NEWS DIGEST OF AQUACULTURE RESEARCH AND DEVELOPMENT. FAO Aquacult. Bull., 5(3-4): 32 p., illus.

Text includes: From research institutions ... New laboratory - Atlantic salmon hatchery - Rearing of grey mullet larvae - Induced breeding and larval rearing of anchovy - Breeding and culture of Clarias - Selective breeding of trout - Production of unisex and sterile fish - Fish feeds - Goldfish as forage of catfish broodstock - Culture of silver carp in sewage-fed ponds - Polyculture of carps - Energy and nutrient balance in grass carp - Pond rearing of Donaldson trout - Culture of flounder - Cage culture of pompano - Container culture of catfish - Removal of excess nutrients from fish ponds - Collection of flat oyster spat - Mosquito control in rice fields. Aquaculture development ... Australia - Brazil - Canada - Colombia - Egypt - Honduras - Israel - Netherlands - Peru - United Kingdom - United States. Fish diseases and their control ... Salmonid virus in Oregon (U.S.A.) - Fibrosarcoma in trout hybrids - Coho salmon anti-Aeromonas antibodies - Fungal disease of salmonids in the Isle of Man - Diseases of pen-reared salmon - Spinal deformities in rainbow and brown trout - Immune response of carp to ichthyophthiriasis - Gill disease in carp - Tumour-like growths in channel catfish - Bacterial pathogen in yellowtail - Protozoan and nematode parasites of Mexican shrimp - Fish disease policy - Fish disease-control bill. Fish and shellfish introductions ... Recent introductions - Regulations on transplanting sea life - Grass carp in the United States - Transplanting salmon stock - Conger eel in the U.S.S.R. - Introduction of Japanese salmon in Chile - Results of oyster introductions in Mauritius. (From contents)

17181. Crossman, John S., and John Cairns, Jr. (Teledyne Brown Engineering, 6022 Technology Drive, Huntsville, Alabama 35807). 1973. THE EFFECT OF pH NEUTRALIZATION OF A POWER PLANT EFFLUENT ON THE CLINCH RIVER. Presented at the 28th Purdue Industrial Waste Conf., May 1-3, 1973 at Purdue Univ., 29 p.

A one year instream biomonitoring study was undertaken on the Clinch River in southwest Virginia to determine the effect of a new pH neutralization unit at Appalachian Power Company's Carbo, Virginia generating plant. Physical, chemical and biological samples were collected at stations above and below the power plant to assess water quality conditions. The physical parameters measured were temperature, conductivity, and stream discharge. Chemical determinations were pH, total hardness, dissolved oxygen, and sulfates. Monthly biological sampling was carried out at one upstream reference station and three downstream stations using brush-box artificial substrates as well as the more common sampling methods. The results obtained for the macrobenthic samples were compared using community structure analyses. (Authors)

17182. Fisheries Research Board of Canada (Ottawa, Canada). 1973. REVIEW OF THE FISHERIES RESEARCH BOARD OF CANADA 1971-1972. Environment Canada, Cat. No.: Fs91-2/1972, 230 p. illus.

17183. Turner, William R., and George N. Johnson (Atlantic Estuarine Fisheries Center, NMFS, NOAA, Beaufort, North Carolina 28516). 1973. DISTRIBUTION AND RELATIVE ABUNDANCE OF FISHES IN NEWPORT RIVER, NORTH CAROLINA. U. S. Dept. of Comm., NOAA Technical Report NMFS SSRF-666, 23 p.

Monthly sampling in Newport River during 1970 disclosed a total of 104 species of fishes within the system. Sampling extended from the lower reaches of the estuary upstream into tidal fresh waters, and covered a mid-channel distance of 34.87 km. To sample as wide a range of species as possible, an array of collecting gear was used, i.e., haul seine, surface trawl, bottom trawls (two sizes), and gill nets. In terms of catch per unit of effort the surface trawl was the most successful gear employed, whereas gill nets, the least efficient gear, captured the greatest variety of species. Most of the species of fishes collected in the system were marine forms. Only 15 essentially freshwater species were collected and 5 of these (longnose gar, gizzard shad, golden shiner, white catfish, and black crappie) showed varying degrees of tolerance for saline waters (0.6-33.7 °/oo). Relative numbers of fishes in collections by the different gears indicated that seven species made up 97% of the total catch which comprised nearly 129,000 individuals. The dominant species were all marine euryhaline forms that used the estuary as a nursery area, penetrating well upstream into brackish or even tidal fresh waters. Seasonal distribution and abundance of the dominant species, as well as other species collected in substantial numbers, are discussed. Biomass of fishes in collections by haul seine was estimated at 0.93 g/m^2 for littoral waters of the estuary. Samples collected by other gears did not yield satisfactory estimates of biomass. (Authors)

17184. Rawstron, Robert R. 1973. COMPARISONS OF DISK DANGLER, TRAILER, AND INTERNAL ANCHOR TAGS ON THREE SPECIES OF SALMONIDS. Calif. Fish and Game, 59(4): 266-280.

Total harvest, annual exploitation, and survival rates of rainbow trout, coho salmon, and brown trout, bearing internal anchor tags with tube (Floy FD-67) and wire frame tags, were compared in several California reservoirs. Angler returns of internal anchor tags yielded estimates of mortality and survival similar to those determined from disk dangler and trailer tags. Because it can be more rapidly applied and is available commercially, the anchor tag was therefore deemed superior. Its major disadvantage was a relatively high initial shedding rate, but this was accounted for in some experiments by retaining tagged fish in the hatchery for 1 to 4 weeks.

17185. Addison, R. F., and R. P. Cote (Fish. Res. Bd. of Canada, Marine Ecol. Lab., Bedford Inst. of Oceanography, Dartmouth, Nova Scotia, Canada). 1973. VARIATION WITH CHAIN LENGTH IN ACUTE TOXICITY OF ALKYLHYDROXAMIC ACIDS TO SALMON (Salmo salar) FRY. Lipids, 8(9): 493-497; U.S. Dept. of Comm. Marine Fisheries Abstracts, 26(12): p. 35.

Fatty acids and some of their derivatives have been used as ore flotation agents. Recently, articles have appeared in the literature that describe the use of hydroxamic acids as flotation agents. These compounds have the structure RCONHOH where R is an alkyl group. Such a flotation agent, used experimentally in Canada, was found to be toxic to brook trout. It is possible that the toxicity of the hydroxamic acids might vary with chain length. In this study, the researchers determined the toxicity of saturated n-alkylhydroxamic acids to salmon fry using acids of chain lengths from n-$CH_3CONHOH$ to n-$C_{15}H_{31}CONHOH$. Acute toxicity was considered as the LT50, time to death of 50% of the test group. Within the series of from n-$C_6H_{13}CONHOH$ to n-$C_{10}H_{21}CONHOH$, the acute toxicity to the salmon fry increased with increasing chain length of the alkylhydroxamic acid. Under similar conditions of the test, the compounds of shorter and longer chain lengths were not toxic.

17186. European Inland Fisheries Advisory Commission (FAO, Rome, Italy). 1971. EIFAC CONSULTATION ON EEL FISHING GEAR AND TECHNIQUES. EIFAC Technical Paper No. 14, 187 p., illus.

17187. Lander, Robert H., and Kenneth A. Henry (Northwest Fisheries Center, NMFS, NOAA, Seattle, Washington 98112). 1973. SURVIVAL, MATURITY, ABUNDANCE, AND MARINE DISTRIBUTION OF 1965-66 BROOD COHO SALMON, Oncorhynchus kisutch, FROM COLUMBIA RIVER HATCHERIES. U.S. Dept. of Comm., NOAA Fishery Bulletin, 71(3): 679-695.

Data are presented estimating the survival, maturity, and abundance of marked coho salmon, Oncorhynchus kisutch, of the 1965-66 broods from 18 to 20 Columbia River hatcheries. Also presented are data depicting the distribution of these fish as caught in the northeastern Pacific Ocean. Compared to fish from hatcheries on the upper reaches of the river, coho salmon from hatcheries near the estuary had a better survival until recruitment to the ocean fishery, a greater proportion maturing as jacks (2-yr olds), and an apparent differential migration pattern in the ocean. For hatcheries from all river sections combined, the parameter estimates differed little between broods. Estimates for both broods are as follows: 9-10% surviving during the 6.0 mo between release of smolts and the return of young males or jacks to the Columbia River; 3-4% of survivors maturing as jacks; 10-12% surviving during the last 12.0 mo of ocean life; 5-6% of the original number of smolts surviving until the time of recruitment to ocean fishing 13.5 mo after release; and exploitation rates of 68-70% in the ocean fishery during the last 4.5 mo of life at sea. (Authors)

17188. Davies, P. H., and W. H. Everhart (Dept. of Fish. & Wildl. Biol., Colo. State Univ., Fort Collins, Colorado). 1973. EFFECTS OF CHEMICAL VARIATIONS IN AQUATIC ENVIRONMENTS: VOLUME III. LEAD TOXICITY TO RAINBOW TROUT AND TESTING APPLICATION FACTOR CONCEPT. Environmental Protection Agency, Ecological Research Series Report, EPA-R3-73-011c, 80 p., available from GPO Sup Doc as EP1.23:73-011c, $1.25; Selected Water Resources Abstracts, 6(18): p. 67.

Four chronic bioassays were conducted to determine the toxicity of lead to rainbow trout. Results obtained from acute and chronic bioassays in hard water (alkalinity 243.1 mg/liter) and soft water (alkalinity 26.4 mg/liter) were used to test the application factor approach as related to different water qualities. The toxicity of lead to rainbow trout in hard water was determined on a total and dissolved lead basis. The 96-hr TL50 and 'MATC' on a total lead basis were 47.1 mg/liter and 0.12 to 0.36 mg/liter respectively, which yielded an application factor of .0002 to .0008. Analysis of the free or dissolved lead gave a 96-hr TL50 of 1.38 mg/liter and a 'MATC' of 0.018 to 0.032 mg/liter, resulting in an application factor of .0130 to .0232. Total and free lead were considered to be the same in soft-water. The 18-day TL50 and 'MATC' obtained from the soft water bioassays were 140 micrograms/liter and 6.0 to 11.9 micrograms/liter lead respectively. Computations using the TL50 and 'MATC' values gave a soft water application factor of .0429 to .0850. The maximum acceptable toxicant concentration ('MATC') was determined in both hard and soft water bioassays on the occurrence of abnormal black tails caused by chronic lead exposure. The application factor approach as related to different water qualities was found to be very promising when lead analysis was limited to the free or dissolved metal and failed when total hard water lead concentrations were used.

17189. Bond, Carl E., and Ting T. Kan (Dept. of Fisheries and Wildlife, Oregon State Univ., Corvallis, Oregon). 1973. Lampetra (Entosphenus) minima n. sp., A DWARFED PARASITIC LAMPREY FROM OREGON. Copeia No. 3, pp. 568-574.

A new species of lamprey, Lampetra (Entosphenus) minima, a dwarfed parasitic derivative of L. tridentata from Miller Lake, Oregon, is described and figured. Adults range from 72 to 129 mm TL. The new species is compared with the related forms, L. lethophaga and L. tridentata. Fish control operations in Miller Lake caused the apparent extinction of L. minima. (Authors)

17190. Schindler, D. W. (Dept. of the Environ. Fish. & Marine Service, Freshwater Inst., Winnipeg, Manitoba R3T 2N6, Canada). 1973. EXPERIMENTAL APPROACHES TO LIMNOLOGY - AN OVERVIEW. J. Fish. Res. Bd. Canada, 30(10): 1409-1413.

17191. Moore, G. K. (FAO Legislation Branch, FAO, Rome, Italy). 1973. THE ROLE OF ADMINISTRATIVE ACTION AS A TOOL IN WATER POLLUTION CONTROL. EIFAC Technical Paper No. 18, 14 p.

This paper examines some aspects of the structure of modern water pollution control administration, and methods of administrative action. It comes to the conclusion that water pollution control cannot be effective if approached from a purely sectoral point of view. What is required in order to protect fisheries adequately from the effects of water pollution is a system of water pollution control and methods of administrative action that allow for the balanced representation of fishery interests with other users' interests at every level of planning and administration. (Auth.'s summ.)

17192. Iwaszkiewicz, Michal (Akademia Rolnicza w Poznaniu, Instytut Zoologii Stosowanej, Poland). 1973. OBSERVATION OF THE LAKE TROUT (Salmo trutta morpha lacustris Linnaeus 1758) INTRODUCED INTO GORZYN LAKE [Wyniki wsiedlenia troci jeziorowej (Salmo trutta morpha lacustris Linnaeus 1758) do jeziora Gorzyn]. Roczniki Nauk Rolniczych, 95(2): 27-35. In Polish with English synopsis and summary.

Results of experimental introducing of the lake trout into a lake having favourable conditions for the fish of subfamily Coregoninae. Means of introducing a species that did not occur in the lake hitherto. Rate of growth of the lake trout in a novel site, feeding, migration within the lake, breeding and localization of spawning grounds. (Auth.'s synopsis)

17193. Havey, Keith A., and Philip S. Andrews (Maine Dept. of Inland Fisheries and Game, Augusta, Maine). 1973. POPULATION DYNAMICS OF HATCHERY-REARED LANDLOCKED SALMON, Salmo salar, AT SCHOODIC LAKE, MAINE. Trans. Amer. Fish. Soc., 102(4): 728-738.

Landlocked salmon, Salmo salar, were introduced into Schoodic Lake, Washington County, Maine in 1960. From 1963-70 we studied nine groups of stocked salmon to obtain information on survival, standing crops, the salmon sport fishery, and population density-catch relationships. Average survival from age I+ to age II+ (four groups) was 47.9%. Average survival from age II+ to age III+ (five groups) was 53.1%. Average survival from age III+ to age IV+ (three groups) was 23.9%. Average survival from age IV+ to age V+ (four groups) was 14.2%. Few salmon survived beyond age V+. Annual survival, excluding fishing mortality for four groups of young salmon ranged from 26.4% to 61.6%. Survival from planting to 6 months at large for one group was 72.6%. Annual survival after death from all causes ranged from 17.6% for one group of salmon from age III+ to age IV+ to 73.1% for one group of salmon from age II+ to age III+. Numerical annual standing crops from 1964-69 computed by the Petersen method ranged from 4.0 $\pm$ 1.0 to 13.8 $\pm$ 2.0 fish per ha. Weight standing crops from 1964-69 ranged from 2.5 $\pm$ 0.4 to 3.4 $\pm$ 1.0 kg per ha. Catch per angler hour by sport fishing ranged from 0.036 in 1969 to 0.229 in 1967. Annual mean number of salmon checked was 164. Salmon creeled averaged 38.6 $\pm$ 0.5 cm in total length and 0.5 $\pm$ 0.04 kg in weight. Based on an estimated 75.0% census, mean numerical yield was 1.4 fish per ha. Mean weight yield was 0.7 kg per ha. Of 12,107 salmon stocked, 8.6% were subsequently checked in anglers' creels. Salmon stocked at age I+, age I, and age 0+ yielded returns of 14.3%, 8.9% and 5.4% respectively. Mean effort per ha per year was 6.9 angler hours. There is a linear relationship (1964-69 data) between population density expressed as numbers per ha and numbers per ha captured by fall trap netting. There is also a linear relationship between population density expressed as numbers per ha and catch per angler hour of all salmon the following fishing season. Indications are that management of small lakes such as Schoodic for salmon can be a fruitful management practice. (Authors)

17194. Moore, George A., Milton B. Trautman, and Milton R. Curd (Zool. Dept., Okla. State Univ., Stillwater, Oklahoma). 1973. A DESCRIPTION OF POSTLARVAL GAR (Lepisosteus spatula Lacépède, LEPISOSTEIDAE), WITH A LIST OF ASSOCIATED SPECIES FROM THE RED RIVER, CHOCTAW COUNTY, OKLAHOMA. The Southwestern Naturalist, 18(3): 343-344.

17195. Matsuk, V. Ye., and V. I. Lapin (Dept. of Ichthyology, Moscow Univ., USSR). 1972. SOME CHARACTERISTICS OF LIPID METABOLISM IN TWO FORMS OF THE ARCTIC CHAR [Salvelinus alpinus (L.)] FROM LAKE AZABACH' YE (KAMCHATKA). J. Ichthyol., 12(5): 838-843.

An examination is made of lipid metabolism in two forms of the Arctic char [Salvelinus alpinus (L.)] from Lake Azabach'ye (Kamchatka), which differ in the nature of their feeding. The main lipid reserves are concentrated in the muscles and on the intestine. Differences in the dynamics of fat accumulation evidently associated with the nature of feeding have been discovered in these forms of the char.

17196. Schmidt, Dana C., and L. J. Weber (Dept. of Fish. & Wildl., Oregon State Univ., Corvallis, Oregon 97331). 1973. METABOLISM AND BILIARY EXCRETION OF SULFOBROMOPHTHALEIN BY RAINBOW TROUT (Salmo gairdneri). J. Fish. Res. Bd. Canada, 30(9): 1301-1308.

The plasma half-life of sulfobromophthalein (BSP) for rainbow trout (Salmo gairdneri) was 13 min for doses of 5 and 10 mg/kg and 29 min for a dose of 15 mg/kg. The biliary BSP transport maximum (Tm) averaged 9.6 μg/min per kg for five fish while the blood clearance averaged 1.7 ml/min per kg for two fish. Normal bile flows of 0.87 μliter/min per kg in trout were increased upon anesthetization but were unaffected in fish allowed to recover from spinal transection. Spinal transection did not affect the plasma half-life of BSP. The data presented support the conclusion that the transport of BSP from liver cells to bile is the rate-limiting step in the excretion of this dye. When the BSP Tm of trout was compared to literature values for mammals and dogfish (Squalus acanthias), large differences were found which were probably caused by effects of different temperatures and blood flows. When the Tm values of the various species were based on blood clearance of BSP (reflecting liver blood flow) the differences were greatly reduced, suggesting similar abilities of the liver of the various species to excrete this dye. (Authors)

17197. Yamane, Shinichi (Dept. of Fish., Fac. of Agric., Miyazaki Univ., Miyazaki, Japan). 1973. LOCALIZATION OF AMYLASE ACTIVITY IN THE DIGESTIVE ORGANS OF THE MOZAMBIQUE MOUTHBROODER, Tilapia mossambica, AND BLUEGILL, Lepomis macrochirus, DETERMINED BY A STARCH SUBSTRATE FILM METHOD. Bull. Jap. Soc. of Sci. Fish., 39(6): 595-603. In English.

The purpose of this study is to detect the localization of amylase activity of fish which are possessed of the stomach or both the stomach and the pyloric caeca by a starch substrate film method, and to make clear the question whether other organs than the pancreas are concerned with the secretion of amylase. In Mozambique mouthbrooder amylolytic activity was found in the pancreatic exocrine tissues, at the luminal surfaces and the lumen of the intestine, and at the outer- and outside of the tracts of the stomach and the intestine. In bluegill the activity was found also in the pancreatic exocrine tissues; at the luminal surfaces and the lumen of the esophagus, the stomach, the pyloric caeca and the intestine; and at the outer- and outside of the wall of the pyloric caeca and the intestine. In both the examined species the mucosa and submucosa showed to be amylase-negative throughout the digestive tract. In sections of the pyloric caeca of bluegill and of the intestine of both species, stained with hematoxylin and eosin, pancreatic ramifications were found to be embedded in or adhere to the wall of the tracts. From the present evidences it seems that amylase production is confined to the pancreatic exocrine cells alone and the mucosal epithelial cells of the digestive tract are not associated with production or secretion of amylase. The present results are accordant with those obtained for the carp, a stomachless fish, which was earlier examined.

17198. Rounsefell, George A. (Univ. of Alabama and Marine Environmental Sciences Consortium, Dauphin Island, Alabama 36528). 1973. COMMENTS ON "EVALUATION OF CAUSES FOR THE DECLINE OF THE KARLUK SOCKEYE SALMON RUNS AND RECOMMENDATIONS FOR REHABILITATION", BY R. VAN CLEVE AND D. E. BEVAN. U. S. Dept. of Commerce, NOAA Fishery Bulletin 71(3): 651-659.

17199. Moul, Edwin T. (Dept. of Botany, Nelson Biol. Labs, Rutgers Univ., New Brunswick, New Jersey 08903). 1973. MARINE FLORA AND FAUNA OF THE NORTHEASTERN UNITED STATES. HIGHER PLANTS OF THE MARINE FRINGE. U.S. Dept. of Comm., NOAA Technical Report NMFS CIRC-384, 60 p.

The common higher plants of the beaches, dunes, morainal cliffs, and tidal marshes of Southern New England are treated in an illustrated key, using only vegetative characters. Both scientific and common names are given. Habitat lists of the plants are included, presenting to the investigator the association of plants as they occur in nature. The range of each plant along the Atlantic coast is designated. A glossary of terms is included. (Auth.)

17200. Hocutt, Charles H., and Patrick S. Hambrick (Dept. of Biol., Va. Polytechnic Inst. and State Univ., Blacksburg, Virginia 24061). 1973. HYBRIDIZATION BETWEEN THE DARTERS Percina crassa roanoka AND Percina oxyrhyncha (PERCIDAE, ETHEOSTOMATINI), WITH COMMENTS ON THE DISTRIBUTION OF Percina crassa roanoka IN NEW RIVER. Amer. Midl. Nat., 90(2): 397-405.

A new Percina hybrid, Percina crassa roanoka X Percina oxyrhyncha, is described from the upper Kanawha (New) River system. Meristic characters of the hybrid were either intermediate or closer to P. c. roanoka; morphometrics indicated intermediacy or similarity to P. oxyrhyncha. P. c. roanoka, originally described from the Roanoke River drainage, is considered to be introduced to the New River system and to have characteristics of an opportunistic species. (Authors)

17201. Lackey, Robert T. (Dept. of Fish. and Wildl. Sci., Va. Polytechnic Inst. and State Univ., Blacksburg, Virginia). 1973. BOTTOM FAUNA CHANGES DURING ARTIFICIAL RESERVOIR DESTRATIFICATION. Water Research, 7(9): 1349-1356.

A 19 ha montane reservoir was kept vertically isothermal by aeration all year round. Four macrobenthic species were abundant during the study: Asellus intermedius (isopod), Chaoborus sp. (phantom midge), Hyalella azteca (amphipod), and Lumbriculus inconstans (annelid). Several species of Chironomidae were presented and treated collectively. Hyalella significantly increased in abundance in shallow water during destratification. Chironomid larvae declined in abundance in the profundal zone during destratification in winter and summer. Asellus, Chaoborus, and Lumbriculus were not significantly altered in abundance during destratification. (Auth.)

17202. Kawai, Shin-ichiro, and Shizunori Ikeda (Dept. Fish., Fac. Agric., Kyoto Univ., Kyoto, Japan). 1973. STUDIES ON DIGESTIVE ENZYMES OF FISHES - III. DEVELOPMENT OF THE DIGESTIVE ENZYMES OF RAINBOW TROUT AFTER HATCHING AND THE EFFECT OF DIETARY CHANGE ON THE ACTIVITIES OF DIGESTIVE ENZYMES IN THE JUVENILE STAGE. Bull. Jap. Soc. Sci. Fish., 39(7): 819-823. In English.

The development of proteases, maltase and amylase activities in the digestive organs of rainbow trout, Salmo gairdneri, after hatching was investigated, and the response of these enzymes to four kinds of experimental diets were also studied for 40 days in the juvenile stage of this fish. The results obtained are as follows. Proteolytic activities of both pepsin-like and trypsin-like enzymes, and activities of maltase and amylase increased greatly during the 20 days after hatching, and 40-60 days after hatching these enzymes reached the activity level of young rainbow trout. The activities of these four digestive enzymes in the juvenile rainbow trout fed various diets were all highest in the high-protein diet group (80% fish meal diet) and were generally proportional to the protein content. The growth rate paralleled the changes in enzyme activities. The results obtained with the juvenile rainbow trout were different from those found previously in the young carp.

17203. Weihs, D. (Dept. of Applied Math. and Theoretical Physics, Univ. of Cambridge, Cambridge, England). 1973. OPTIMAL FISH CRUISING SPEED. Nature, 245(5419): 48-50.

Derivation of the equation $(Wp)_{max} = W_m$, which describes the optimal cruising speed of fish, is presented.

17204. Piper, Donald, Bruce L. Nicholson, and James Dunn (Dept. Microbiol., Univ. of Maine, Orono, Maine 04473). 1973. IMMUNOFLUORESCENT STUDY OF THE REPLICATION OF INFECTIOUS PANCREATIC NECROSIS VIRUS IN TROUT AND ATLANTIC SALMON CELL CULTURES. Infection and Immunity 8(2): 249-254; Fish Health News, 2(4): p. 9.

Cell cultures of trout gonad tissue (RTG-2) and Atlantic salmon heart, kidney, liver, and spleen tissue were inoculated with 50 50% tissue culture infective doses ($TCID_{50}$) of infectious pancreatic necrosis (IPN) virus per cell, and the titer of cell-associated and released virus was determined from 2 to 16 h postinoculation (PI). Cover slips were collected over the same period and stained for IPN viral antigen by the direct immunofluorescent (FA) technique. Viral replication was detected after a latent period of approximately 2 to 4 h and reached a peak titer of $10^{8.2}$ to $10^{8.4}$ $TCID_{50}$ per ml at 8 to 10 h PI. The release of virus was more rapid in Atlantic salmon cells than in RTG-2 cells. Viral antigen was first detected by FA from 3 to 4 h PI. Approximately 75 to 80% of the cells contained antigen in the cytoplasm 9 to 11 h PI. The direct FA technique was found to be a sensitive method for detecting IPN virus in infected cells. Three strains of IPN virus were tested for serological cross reactions by FA and virus neutralization tests. (Authors)

17205. Ikeda, Yayoi, Hisao Ozaki, Kazuo Uematsu (Radioisotope Research Lab., Tokyo Univ. Fish., Minato-ku, Tokyo 108, Japan). 1972. SERUM IRON LEVEL AND TOTAL IRON BINDING CAPACITY IN CULTURE FISH. J. Tokyo Univ. Fish., 59(1): 43-53. In Japanese.

The serum iron levels, total iron binding capacities and iron saturation rates were determined by the Matsubara's and Ramsay's methods in three cultured fish, yellowtail (Seriola quinqueradiata), rainbow trout (Salmo irideus) and carp (Cyprinus carpio). In yellowtail, the serum iron level, unvarying during the period of June to December, directly correlated with the specific growth rate of body weight and dropped in feeding on the fish meal compound diets containing 0 or 27.3 mg % dry weight of iron as iron succinate, but recovered in that with 57.3 mg % of iron added. In rainbow trout, serum iron level was higher in May than in March and indifferent to whether in freshwater or in seawater. In carp, the level, the lowest among the three species, was less than half as much as that in yellowtail. The serum iron levels seemed to be related to the species, activity, diet quality and water temperature. The total iron binding capacities were almost the same in the three species. In yellowtail, iron saturation rate was the highest, but dropped with increased total iron binding capacity when fed on the compound diet deficient in iron. Between rainbow trout in freshwater and in seawater, slight differences were observed in total iron binding capacity and iron saturation rate. In carp, iron saturation rate was the lowest. The feeding on the compound diet deficient in iron caused a rise in total iron binding capacity and a decline in iron saturation rate. The above three determinations are thought to be helpful to diagnose nutritional status or some diseases. The increase in total iron binding capacity was attributed to a rise in transferrin present in the third fraction of serum protein in yellowtail fed on the diet deficient in iron.

17206. Wilson, Robert P. (Dept. of Biochem., Mississippi State Univ., State College, Mississippi). 1973. NITROGEN METABOLISM IN CHANNEL CATFISH, Ictalurus punctatus - II. EVIDENCE FOR AN APPARENT INCOMPLETE ORNITHINE-UREA CYCLE. Comp. Biochem. Physiol., 46(3B): 625-634.

The activities of carbamyl phosphate synthetase, ornithine transcarbamylase, arginine synthetase system and arginase were measured in liver and kidney homogenates of cultured and native channel catfish. Significant levels of carbamyl phosphate synthetase, ornithine transcarbamylase and arginase were detected in liver tissue, whereas only ornithine transcarbamylase and arginase were detected in kidney tissue. The liver and kidney arginases were activated by Mn^{2+} ions and exhibited Km values similar to those previously reported for ureotelic species. (Auth.)

17207. Matthiessen, P., and A. E. Brafield (Dept. of Biol., Queen Elizabeth College (Univ. of London), Campden Hill Road, London W.8, England). 1973. THE EFFECTS OF DISSOLVED ZINC ON THE GILLS OF THE STICKLEBACK Gasterosteus aculeatus (L.). J. Fish Biol., 5(5): 607-613

Concentrations of 0.5-1.0 mg Zn^{2+}/dm^3 distilled water killed sticklebacks after 1-3 days, producing detachment and sloughing of epithelial cells, and coalescing of adjacent secondary lamellar epithelia. Cytoplasmic abnormalities included extensive vacuolation followed by swelling of nuclei and mitochondria leading to cellular disintegration. Many acutely poisoned fish recovered in zinc-free hard water, regeneration of epithelia being accompanied by a temporary appearance of chloride cells on the secondary lamellae. Concentrations of 2.0-6.0 mg Zn^{2+}/dm^3 hard water water were not toxic over periods of up to 700 h. Extensive cytoplasmic abnormalities appeared, however, including the formation of membrane bounded vesicles and dense accumulations of metabolites. The most pronounced effect was the appearance of active chloride cells on the secondary lamellae. The possible involvement of chloride cells in the excretion of ions other than chloride is briefly discussed. (Authors)

17208. Kuperman, B. I., and R. E. Shul'man (Leningrad State Univ., USSR). 1972. EXPERIMENTAL STUDY OF THE EFFECT OF TEMPERATURE ON SOME PIKE PARASITES. Vestn. Leningr. Univ. Ser. Bio., 27(1): 5-15. In Russian with English summary. Selected Water Resources Abstracts, 6(21): p. 77.

The effect of temperature on the lifecycle of Triaenophorus nodulosus, T. crassus and Ergasilus sieboldi was investigated. The change of temperatures from winter and autumn to spring and summer had different effects on the parasites. The temperature affects the parasites indirectly, as it changes the physiological state of the host, and this in turn affects the parasites. -- Biological Abstracts, Inc.

17209. Sano, Tokuo, and Takayoshi Yamazaki (Tokyo Univ. of Fish., Konan 4-5-7, Minato-ku, Tokyo 108, Japan). 1973. STUDIES ON VIRAL DISEASES OF JAPANESE FISHES - V. INFECTIOUS PANCREATIC NECROSIS OF AMAGO TROUT. Bull.Jap. Soc. Sci. Fish., 39(5): 477-480. In English.

An IPN-like epizootic with high mortality occurred among Amago, Oncorhynchus rhodurus macrostomus, reared in a rainbow trout farm. The cumulative mortality was about 28%. Histopathological examinations showed that intensive congestion, hemorrhage and necrosis in the kidneys were rather more evident than was necrosis in the pancreatic tissue. Inoculants prepared from the diseased Amago fry showed the isolant to have a titer of about $10^{8.5}$ $TCID_{50}$/ml. Neutralization tests of the agent with IPN polyvalent antiserum indicated that the agent was an IPN virus. This is the first case of an IPN outbreak among Oncorhynchus reared in Japan. Yamame reared in nearby ponds of the same farm showed no mortality and no agent could be isolated.

17210. Schneberger, Edward, and John L. Funk (editors). 1973. STREAM CHANNELIZATION: A SYMPOSIUM. N. C. Div. Amer. Fish. Soc. Spec. Pub. 2, 83 pp. Available from Amer. Fish. Soc., 1319 - 18th St., N. W., Washington, D. C. 20036, $2.00 per copy.

Eight papers presented at a symposium held at the 33rd Midwest Fish and Wildlife Conference in Omaha, Nebraska in December, 1971. One deals with the general status of stream channelization in the Midwest. One each presents the viewpoints of the U. S. Army Corps of Engineers and the Soil Conservation Service on the subject. Four deal with the effects of channelization on the biological productivity and recreational values of streams. One presents a brief literature review and bibliography. -- John L. Funk

17211. Huizinga, H. W., and G. E. Cosgrove (Dept. of Biol. Sci., Illinois State Univ., Normal, Illinois). 1973. SURFACE AND VISCERAL LYMPHOCYSTIS DISEASE IN A WHITE CRAPPIE, Pomoxis annularis. Journal of Wildlife Diseases, 9(4): 349-351.

17212. Collins, H. L., J. R. Davis, and G. P. Markin (U. S. Dept. of Agric., Anim. and Plant Health Insp. Service, Gulfport, Mississippi). 1973. RESIDUES OF MIREX IN CHANNEL CATFISH AND OTHER AQUATIC ORGANISMS. Bulletin of Environmental Contamination and Toxicology, 10(2): 73-77.

A 3-acre fish pond was treated with mirex bait at the rate of 1.7 grams toxicant/acre. Mirex residues did build up in uncaged channel catfish whereas larger caged fish acquired no detectable mirex, and only minute levels of mirex were detected in caged fingerlings. This is probably due to the fact that the caged fish did not have a ready access to the natural food chain, as did the uncaged fish, thus detectable residues of mirex did not accumulate in the larger caged fish. Residues in uncaged channel catfish were not detected at 5 days after treatment, but began to increase after that, reaching a maximum of 0.65 ppm 6 months after treatment. Sixteen months after treatment uncaged catfish contained 0.44 ppm mirex.

17213. Massaro, Edward J. (Dept. of Biochem., State Univ. of New York at Buffalo, Buffalo, New York). 1973. THE LACTATE DEHYDROGENASE ISOZYMES OF Coregonus hoyi GILL (PISCES: SALMONIDAE): TISSUE DISTRIBUTION, IMMUNOCHEMISTRY AND MOLECULAR WEIGHT. Comp. Biochem. Physiol., 46(2A): 353-357.

Starch gel electrophoresis at pH 8.6 resolved five anodally migrating groups of isozymes, denoted a, i, b, d and e. The groups exhibited differential tissue expression. At least twenty-one isozymes were observed: five a- and d-, four i- and b- and three e-group isozymes. In duodenum/pyloric caeca extracts, a- and b-group isozymes were expressed exclusively in females. A unique group, the mobility of which overlapped that of the b- and d-groups, was found in males. The most anodal i-group isozyme of skeletal muscle exhibited variable expression. All isozyme groups appeared to be immunologically distinct. The molecular weight of the tetramer was estimated to be $\sim$ 140,000; that of the monomer, $\sim$ 35,000. (Auth.)

17214. Echelle, Anthony A., Stan Wilson, and Loren G. Hill (Univ. of Okla. Biol. Station, Kingston, Oklahoma). 1973. THE EFFECTS OF FOUR TEMPERATURE-DAYLENGTH COMBINATIONS ON OVOGENESIS IN THE RED RIVER PUPFISH, Cyprinodon rubrofluviatilis (CYPRINODONTIDAE). The Southwestern Naturalist, 18(2): 229-239.

Ovarian development in Cyprinodon rubrofluviatilis was relatively unaffected by the daylength treatments (7 hr photoperiod vs. 15 hr period) compared with the effects of the test temperatures (15°C vs. 30°C). Large eggs near maturity were produced by all experimental groups, but individuals of the 15°C groups had greater mean egg diameters and gonosomatic indexes than those of the 30°C groups. The latter groups had much greater coefficients of condition (K_{TL}) than the former, apparently as a result of higher energy intake and high metabolic efficiency. The explanation of the differential ovarian development may lie partially in a competitive relationship between ovarian and somatic mass, with high proportions of assimilated energy shunted to somatic tissues at high temperatures. The pupfish seems to have low temperature thresholds for reproductive functions (ovogenesis and spawning), and this conforms well with the apparent ecological role of this species. (Authors)

17215. Pinganaud-Perrin, G. (Lab. d'Anatomie Comparee, Univ. Paris VII, 2 Place Jussieu 75005, Paris, France). 1973. THE EFFECTS OF EYE ABLATION IN THE MORPHOGENESIS OF THE TROUT SKULL (Salmo irideus Gib.) [Effets de l'ablation de l'oeil sur la morphogenese du chondrocrane et du crane osseux de Salmo irideus Gib.]. Acta Zoologica, 54(3): 209-221. In French.

Removal of one or both eyes in rainbow trout (from 8 days before hatching to 6 days after) causes some malformations of development of chondrocranium and skull bones. The observations prove that they have a mechanical origin: they are due to a modification of the forces existing in the orbit region during the morphogenesis. Height of orbit is reduced by taenia marginalis sliding down, and length of orbit is reduced by lamina orbitonasalis moving backwards. The bone reproduces exactly cartilage deformations. (Auth.)

17216. Johansson, N., A. Larsson, and K. Lewander (Salmon Res. Inst., Alvkarleo, Sweden). 1972. METABOLIC EFFECTS OF PCB (POLYCHLORINATED BIPHENYLS) ON THE BROWN TROUT (Salmo trutta). Comp. Gen. Pharmacol., 3(11): 310-314; Selected Water Resources Abstracts, 6(20): p. 68.

Brown trout were given a total of 10 microgram PCB/g body-weight. The effects on different metabolites in blood, liver, and muscle were studied after 43 and 203 days. During the first 43 days the fish were fed. On day 43 the PCB-treated trout showed blood anemia, hyperglycemia, enlargement of the liver, and altered cholesterol metabolism. Between 43 and 203 days the fish were subjected to 4 mo. starvation followed by a refeeding period. On day 203 the PCB-treated trout showed higher body-weights, lower muscle glycogen levels, and a more pronounced decrease in liver triglycerides. -- Biological Abstracts, Inc.

17217. Brinkhurst, R. O. (Fish. Res. Bd. of Canada, Biol. Sta., St. Andrews, New Brunswick, Canada). 1973. MARINE AND BRACKISH WATER OLIGOCHAETA. Fish. Res. Bd. of Canada Technical Report No. 420, 9 p., manuscript status.

While there are marine and brackish representatives of most families of oligochaetes, the majority of species are to be found in the Tubificidae and Enchytraeidae. Zoogeographic distribution varies from cosmopolitan to highly endemic, with other patterns (pan-Atlantic; pan-American; European including Mediterranean and Black Sea, for example) that may prove to be of significance. Ecologically, most oligochaetes tolerate wide ranges of temperature and salinity. Same correlations between worm distribution and particle size can be observed. Oligochaetes are usually found in multi-specific clumps, and recent work demonstrates positive interactions in which mixed cultures move and respire less, eat and grow more than the same individuals in isolation. Niche discrimination is probably related to specific food requirements, often the faeces of other worm species being a preferred food source. (Auth.)

17218. Cairns, John, Jr., K. L. Dickson, and Guy Lanza (Biol. Dept. and Center for Environmental Studies, Va. Polytechnic Inst. and State Univ., Blacksburg, Virginia 24061). 1973. RAPID BIOLOGICAL MONITORING SYSTEM FOR DETERMINING AQUATIC COMMUNITY STRUCTURE IN RECEIVING SYSTEMS. Biological Methods for the Assessment of Water Quality, ASTM STP 528, American Soc. for Testing and Materials, pp. 148-163.

Biological monitoring plays an important role in a pollution monitoring program providing information not available through conventional physical and chemical monitoring. The saprobic system and the use of structural and functional changes in aquatic communities are two approaches utilized in assessing the effects of pollutants on aquatic communities. The feedback of information from conventional instream biological monitoring has been too slow for the most effective management of an aquatic system. Two rapid biological monitoring systems (the Sequential Comparison Index, and an automated community structure analysis using laser holography) have been developed to increase the speed of data collection and data analysis. (Authors)

17219. Rudd, John W. M., and R. D. Hamilton (Fish. Res. Bd. of Canada, Freshwater Inst., Winnipeg, Manitobe R3T 2N6, Canada). MEASUREMENT OF ADENOSINE TRIPHOSPHATE (ATP) IN TWO PRECAMBRIAN SHIELD LAKES OF NORTHWESTERN ONTARIO. J. Fish. Res. Bd. Canada, 30(10): 1537-1546.

Profiles of the adenosine triphosphate (ATP) concentrations occurring in the particulate material of two experimental shield lakes were obtained with respect to time. Large seasonal changes were evident, as were specific sites of high biological activity due either to natural stratification or to deliberate manipulation. Chlorophyll a, particulate carbon, and direct count data were found to be misleading in specifying the changes or the sites of biological activity. Analysis of the ATP data on the basis of the relative abundance of different size fractions was found to be useful. An ATP filtration error could not be demonstrated, indicating that cell breakage is not a source of the filtration error inherent in some ^{14}C primary and secondary productivity studies. (Authors)

17220. Islam, Md. Aminul, Yukio Nose, and Fujio Yasuda (Fac. of Fisheries, Bangladesh Agric. Univ., Mymensingh, Bangladesh). 1973. EGG CHARACTERISTICS AND SPAWNING SEASON OF RAINBOW TROUT. Extracted from the thesis work of Md. Aminul Islam for Dr. of Agric. in Univ. of Tokyo; Bull. Jap. Soc. Sci. Fish., 39(7): 741-751. In English.

A linear relationship was observed between body weight and total weight of eggs, number of eggs and egg diameter. Egg diameter was found almost independent of body weight in age group 4. Smaller specimens (both in age and in size) showed higher values of regression coefficient in all the characters. Annual variation did not seem to occur in the majority of the surveyed hatcheries. Variation in different age groups of a particular hatchery was observed. Interhatchery variation was observed in all the characters. Akashina and Okutama exhibited higher values of total weight of eggs, gonad index and number of eggs while Hiruzen exhibited higher values of egg diameter. Total weight of eggs was large in Fujinomiya but gonad index became less due to the extraordinary size of the specimens. Total weight and number of eggs were found to vary in the early, mid and late spawning groups in Okutama. The late spawning group exhibited higher values for the above two characters followed by the mid and the early spawning groups. An attempt was made to find out some interrelationships among the different characters.

17221. Richardson, Sally L. (School of Oceanography, Oregon State Univ., Corvallis, Oregon 97331). 1973. ABUNDANCE AND DISTRIBUTION OF LARVAL FISHES IN WATERS OFF OREGON, MAY-OCTOBER 1969, WITH SPECIAL EMPHASIS ON THE NORTHERN ANCHOVY, Engraulis mordax. U. S. Dept. of Comm., NOAA Fishery Bulletin, 71(3): 697-711.

Quantitative information on larval fishes in waters off Oregon is presented. Three hundred fifty-four samples, containing 55,049 larvae, were taken from lat. 42°00' to 46°30'N and from the coastline to long. 129°30'W during six cruises, May to October 1969. Catches by three types of gear - bongos, meter net, and Isaacs-Kidd midwater trawl - are compared. The midwater trawl captured the greatest number of taxa and had the greatest frequency of occurrence of major taxa while overall the bongos caught the most larvae per 1,000 m^3 of water filtered. Shallow tows compared with deep tows from the same stations showed small anchovy larvae were concentrated near the surface while larvae of myctophids and scorpaenids were more common in deeper waters. Species composition (40 taxa in 22 families from deep tows), frequency of occurrence, abundance, and dominance are discussed. Northern anchovy, Engraulis mordax; northern lampfish, Stenobrachius leucopsarus; blue lanternfish, Tarletonbeania crenularis, and Sebastes spp. were the most dominant taxa. Distributional features of species in the most important families are described. E. mordax larvae were concentrated in Columbia River plume waters from June to August. (Auth.)

17222. Vlasenko, M. I. (All-Union Inst. of Exp. Vet. Surgery, Moscow, USSR). 1972. THE USE OF AN ELECTRIC CURRENT IN THE PROPHYLAXIS OF DIPLOSTOMATOSIS IN FISH. J. Ichthyol., 12(5): 844-849.

An account is given of the results of laboratory experiments to determine the sensitivity of the causative agents of diplostomatosis in fish, the cercariae of Diplostomum spathaceum Rud., to alternating current at the commercial frequency. The use of an electric current in the control of diplostomatosis is shown to be effective and desirable. The essential parameters and the conditions for the use of an electric current in hatchery practice are given.

17223. Luke, D. McG., D. G. Pincock, and A. B. Stasko (Electrical Engineering Dept., Univ. of New Brunswick, Fredericton, N. B., Canada). 1973. PRESSURE-SENSING ULTRASONIC TRANSMITTER FOR TRACKING AQUATIC ANIMALS. J. Fish. Res. Bd. Canada, 30(9): 1402-1404.

A small transmitter (7 x 1.6 cm) for telemetering swimming depth of aquatic animals was developed. The transmitter operates for 3 days with a signal range of about 1 km in sea water. It codes depth to 40 m or more as changes in pulse repetition rates, detectable by standard ultrasonic receivers. (Authors)

17224. Chevalier, John R. (Dept. of Natural Resources, N. Y. State Coll. of Agric. and Life Sciences, Cornell Univ., Ithaca, New York 14850). 1973. CANNIBALISM AS A FACTOR IN FIRST YEAR SURVIVAL OF WALLEYE IN ONEIDA LAKE. Trans. Amer. Fish. Soc., 102(4): 739-744.

This study was undertaken to evaluate the role of cannibalism in determining year class strength of walleyes. From mid-July 1969 to May 1970, I monitored the abundance of young walleyes by trawling and examined stomachs of adult walleyes collected in trawls and gill nets. Number of young walleyes consumed was estimated from occurrence in adult walleye stomachs, digestion rates, and estimated number of adults. Daily consumption ranged from 0.044 young walleyes per adult in August to 0.002 during the winter. Monthly cannibalism, estimated by the multiplication of daily consumption by the number of days and the number of adult walleyes, varied from 1,053,000 young in August to 240,000 during the winter. Cannibalism declined proportionally with abundance of young walleyes. Overwinter mortality rates in 1969-1970 were highest for small young-of-the-year walleyes because adult walleyes were size-selective in preying upon young. (Auth.)

17225. Minckley, Charles O., and James E. Deacon (Dept. of Biol. Sciences, Univ. of Nevada, Las Vegas, Las Vegas, Nevada 89154). 1973. OBSERVATIONS ON THE REPRODUCTIVE CYCLE OF Cyprinodon diabolis. Copeia No. 3, pp. 610-613.

The reproductive cycle of C. diabolis appears to reach a peak in May and a low point in fall and winter. There may be a mechanism permitting unseasonal spawning, provided environmental conditions are satisfactory. Certain principles are suggested which should be considered in attempts to save the species by removal of individuals for experimental rearing or transplant. 1) The months of April, May and June will most likely be most suitable for removal of individuals since they are likely to be replaced by newly hatched individuals. 2) With careful surveillance the population might withstand some harvesting at other times of the year. 3) Fecundity is not high; an average female may have about 4-5 ova or 10-20% of her total complement in a mature condition during the peak reproductive season. 4) Introduction of C. diabolis into a new habitat at any time of the year could result in spawning if it is true that population control is density-dependent.

17226. Ogino, Chinkichi, and Mao-Song Chen (Lab. Fish. Biochem., Tokyo Univ. of Fisheries, Konan 4, Minato-ku, Tokyo, Japan). 1973. PROTEIN NUTRITION IN FISH - III. APPARENT AND TRUE DIGESTIBILITY OF DIETARY PROTEINS IN CARP. Bull. Jap. Soc. Sci. Fish., 39(6): 649-651.

The purpose of the present study is to elucidate the relationship between the amount of nitrogen ingested by carp and the apparent digestibility or the true digestibility of dietary proteins. The method of fecal collection and quantitative determination of metabolic fecal nitrogen excretion of carp reported in the previous paper was adopted. The true digestibility of dietary proteins manifested no appreciable change regardless of the nitrogen intake of the fish, while the apparent digestibility was noticeable at levels of nitrogen intake below 100 mg per 100 g of weight per day. The true digestibilities of dietary proteins determined in carp showed high values exceeding 90% in all samples.

17227. Iwaszkiewicz, Michal, and Antoni Przybyl (Akademia Rolnicza w Poznaniu, Inst. Zoologii Stosowanej, Poland). 1973. PARASITES FOUND IN THE SEA TROUT (Salmo trutta morpha trutta Linnaeus 1738) DURING ITS STAY IN SPAWNING GROUNDS. [Pasozyty stwierdzone u trici wedrownej (Salmo trutta morpha trutta Linnaeus 1758) w czasie jej pobytu na tarliskach]. Roczniki Nauk Rolniczych, 95(2): 37-41. In Polish with English summary.

Parasites of the sea trout caught on a spawning ground were determined. Two ectoparasite species (Piscicola geometra L. and Argulus foliaceus L.) and one endoparasite species (Abothrium crassum Bloch.) were found to occur in the fish.

17228. Brown, V. M. (Water Pollut. Res. Lab., Stevenage, England). 1973. CONCEPTS AND OUTLOOK IN TESTING THE TOXICITY OF SUBSTANCES TO FISH. Chemical Abstracts, 49(9): 49577p; Marine Fisheries Abstracts, 26(12): p. 29.

17229. Rawstron, Robert R. 1973. HARVEST, MORTALITY, AND COST OF THREE DOMESTIC STRAINS OF TAGGED RAINBOW TROUT STOCKED IN LARGE CALIFORNIA IMPOUNDMENTS. Calif. Fish and Game, 59(4): 245-265.

Rainbow trout of three strains were tagged and planted in four California impoundments: Lake Berryessa, Merle Collins Reservoir, Pine Flat Lake, and Lake Isabella. Coleman Kamloops consistently outperformed the Shasta and Whitney strains. They had similar mean annual exploitation rates, the highest survival rates, highest ratio of weight returned to weight planted, and lowest cost/lb to the angler's creel compared to the other strains. Their superior performance is attributed to their limnetic distribution and their decreased vulnerability to shore anglers shortly after planting. Where emigration into downstream areas occurred Whitney rainbows emigrated at the highest rate, followed in order by the Coleman Kamloops and Shasta strains. No difference in growth rate occurred among the three strains.

17230. Hesslein, R., and P. Quay (Lamont-Doherty Geological Observatory, Columbia Univ., Palisades, New York 10964). 1973. VERTICAL EDDY DIFFUSION STUDIES IN THE THERMOCLINE OF A SMALL STRATIFIED LAKE. J. Fish. Res. Bd. Canada, 30(10): 1491-1500.

Values for K, the coefficient of vertical eddy diffusion in the thermocline of lake 227, a small, highly stratified, and artificially eutrophied lake in northwestern Ontario, Canada, are presented. Three methods: the classical temperature method of McEwen, a dye method, and a new method using a RAGAPOS (Radon Gas Point Source), were used. Results ranged from 2×10^{-4} cm^2/sec by the Rn method to 34×10^{-4} cm^2/sec by temperature method; the dye method resulted in an average value of 12×10^{-4} cm^2/sec. The recycling of ΣCO_2 resulting from particulate degradation below the epilimnion was calculated. The results ranged from 8 to 53% of the net loss of carbon from the epilimnion depending on the K value used. Results from the radon method are considered to be more accurate than results from the temperature method. (Authors)

17231. Childs, E. A., and J. N. Gaffke (Seafoods Lab., Dept. of Food Sci. and Technology, Oregon State Univ., Astoria, Oregon 97103). 1973. MERCURY CONTENT OF OREGON GROUNDFISH. Technical Paper No. 3422, Ore. State Univ. Agric. Exp. Sta.; U. S. Dept. of Comm., NOAA Fishery Bulletin, 71(3): 713-717.

The mercury content of Oregon groundfish was determined. The mercury content of rex sole, Glyptocephalus zachirus; Dover sole, Microstomus pacificus; petrale sole, Eopsetta jordani; English sole, Parophrys vetulus; sand sole, Psettichthys melanostictus; starry flounder, Platichthys stellatus; canary rockfish, Sebastes pinniger; flag rockfish, Sebastes rubrivinctus; yellowtail rockfish, Sebastes flavidus; rougheye rockfish, Sebastes aleutianus; sablefish, Anoplopoma fimbria; lingcod, Ophiodon elongattus, Pacific hake, Merluccius productus; and arrowtooth flounder, Atheresthes stomias; was significantly lower than 0.50 ppm mercury. All spiny dogfish, Squalus acanthias, samples contained $>$ 0.50 ppm. No highly significant relationship in those species appropriately examined between (a) catch location, (b) time of catch, (c) weight and length of fish, or (d) sex and mercury content was observed. (Authors)

17232. Smith, Barry W., and R. T. Lovell (Dept. of Fish. and Allied Aquacultures, Auburn Univ., Auburn, Alabama 36830). 1973. DETERMINATION OF APPARENT PROTEIN DIGESTIBILITY IN FEEDS FOR CHANNEL CATFISH. Trans. Amer. Fish. Soc., 102(4): 831-835.

Digestibility studies of channel catfish were conducted with purified rations and commercial catfish feeds. The chromium oxide indicator method used in this study appeared to be satisfactory for determining apparent protein digestibility in foods with channel catfish. Desirable features of our procedure were that the fish consumed food approximating 2% of body mass voluntarily and feces for determining digestion coefficients were collected exclusively from the rectum. Derived digestion coefficients with practical diets indicated that digestion coefficients in livestock feeding tables for concentrated feedstuffs may be applied to catfish feeds. (Authors)

17233. Oloffs, P. C., L. J. Albright, S. Y. Szeto, and J. Lau (Dept. of Biol. Sciences, Simon Fraser Univ., Burnaby 2, Brit. Columbia, Canada). 1973. FACTORS AFFECTING THE BEHAVIOR OF FIVE CHLORINATED HYDROCARBONS IN TWO NATURAL WATERS AND THEIR SEDIMENTS. J. Fish. Res. Bd. Canada, 30(11): 1619-1623.

Water samples from the Fraser River and Georgia Strait, British Columbia were treated with different chlorinated hydrocarbons and incubated for up to 12 weeks at 13 C. 1) In the presence of bottom sediments from the same locations as the waters, no residues were found to escape into the atmosphere. 2) With the exception of lindane in ocean water, all detectable residues had moved into the sediments after 6 weeks. 3) Most of the lindane was metabolized. 4) Sterilization of the waters and sediments prevented the metabolism of lindane but had little effect on DDT and DDD. 5) Agitation of water samples containing γ-chlordane, incubated without sediment, had no effect on its disappearance, but the presence of 0.01% of a nonionic surfactant retarded this almost completely. (Authors)

17234. Burrows, W. Dickinson, and Peter A. Krenkel (Associated Water and Air Resources Engineers, Inc., Nashville, Tennessee 37204). 1973. STUDIES ON UPTAKE AND LOSS OF METHYLMERCURY-203 BY BLUEGILLS (Lepomis macrochirus Raf.). Environmental Science and Technology, 7(13): 1127-1130.

The uptake of methylmercury-203 directly from water by bluegills was found to be nearly constant after five days at about 20% per gram of fish per liter of water. Transferred to mercury-free water at 24°C, bluegills exhibited a rapid loss of about 40% of the mercury, followed by a slow loss with a half-time of about five months. Mercury levels in the liver and kidneys were two to seven times higher than whole fish levels, but there was no discernible trend in this ratio with time. The proportion of mercury present as methylmercury in the whole fish remained at 73 ± 10% throughout the course of the experiment. The proportion of methylmercury in the liver and kidneys, however, fell rapidly in the first few weeks after exposure, ultimately leveling off at about 10%. This suggests that biochemical demethylation is taking place in these organs. (Authors)

17235. Stauffer, Thomas M. 1973. FECUNDITY OF COHO SALMON FROM LAKES MICHIGAN AND SUPERIOR. Michigan Dept. of Nat. Res., Fish. Div., Fisheries Research Report No. 1806, 21 p.

Coho salmon in five spawning runs were examined for egg number, egg size, ovary weight, nonviable eggs and eggs retained. One spawning run in a Lake Michigan tributary (Platte River) in 1969 originated from West Coast eggs while two spawning runs there in 1970 and 1972, and runs in two Lake Superior tributaries (Anna and Huron rivers) in 1970, originated from salmon that had spent their entire life in fresh water. Numbers and sizes of eggs were significantly correlated with salmon length and weight in all spawning runs except in the Anna River, where egg size and salmon length were not correlated. For salmon from the Platte River, eggs per female averaged 3,096; average egg diameter was 7.2 mm. Weight of ovary of these salmon was about one-fourth the total body weight. Nonviable eggs comprised less than 3% of the total egg number, and egg retention of salmon found dead was about one-third of the total egg complement. There was no important difference in any of the above parameters between salmon originating from West Coast eggs and eggs produced in fresh water. Number and size of eggs from salmon produced in the Great Lakes were similar to that found for West Coast coho salmon. For salmon in the two Lake Superior tributaries, number of eggs per female averaged 1,973; average diameter was 5.2 mm. Their ovary weight was only about one-eighth of the total body weight, the percentage of nonviable eggs was less than 1%, and one-eighth of the total egg complement was retained by salmon found dead. Platte River fish differed from Lake Superior fish in that they had both more eggs and larger eggs, a greater percentage of their weight was made up of ovarian tissue, and they appeared to have a higher rate of egg retention. Eggs of salmon in all five samples appeared normal in every respect, which suggests that coho salmon will become part of the indigenous fauna of the Great Lakes. (Auth.)

17236. Fisher, Stuart G., and Gene E. Likens (Dept. of Biol., Amherst College, Amherst, Massachusetts 01002). 1973. ENERGY FLOW IN BEAR BROOK, NEW HAMPSHIRE: AN INTEGRATIVE APPROACH TO STREAM ECOSYSTEM METABOLISM. Ecological Monographs, 43(4): 421-439.

An annual energy budget is presented for Bear Brook, a small undisturbed second-order stream in northeastern United States. The ecosystem approach, in which all input and output fluxes of potential energy as organic matter are considered, is used to describe the dynamics of energy flow in a 1,700-m segment of the stream. The annual input of energy to the system is 6,039 Kcal/m^2. Over 99% of this is allochthonous, from the surrounding forested watershed or from upstream areas. Autochthonous primary production by mosses accounts for less than 1% of the total energy available to the ecosystem. Algae and vascular hydrophytes are absent from the stream. Meteorologic inputs (litter and throughfall) from the adjacent forest account for 44% of annual energy input. Most of this is in particulate form. The remaining 56% of input enters by geologic vectors (inflowing surface and subsurface waters). Eighty-three percent of the geologic input and 47% of the total input of energy occur as dissolved organic matter. Approximately 4,730 Kcal/m^2 of organic detritus, nearly equally divided between leaves and branches, is stored within the system. The size of this detritus reservoir is stable from year to year. The turnover time of the branch compartment is about 4.2 years; of the leaf compartment, about 1 year. Although much of the annual input of energy is in a dissolved state, dissolved organic matter does not tend to accumulate in the system and displays a very rapid rate of turnover. Sixty-six percent of annual energy input is exported to downstream areas in stream water. The remaining 34% is lost as heat through consumer activity. Bear Brook is a strongly heterotrophic steady-state system in which import and export of organic matter play a significant role. A conceptual scheme is presented by which import, export, photosynthesis, and respiration may be used to describe the functional dynamics and developmental processes of ecosystems. (Authors)

17237. Wolf, Ken, M. C. Quimby, L. L. Pettijohn, and M. L. Landolt (Eastern Fish Disease Lab., Kearneysville, West Virginia 25430). 1973. FISH VIRUSES: ISOLATION AND IDENTIFICATION OF INFECTIOUS HEMATOPOIETIC NECROSIS IN EASTERN NORTH AMERICA. J. Fish. Res. Bd. Canada, 30(11): 1625-1627.

Infectious hematopoietic necrosis virus (IHNV) was isolated from diseased fingerling rainbow trout (Salmo gairdneri) from a hatchery in West Virginia. Clinical signs, histopathologic findings, and origin of eggs provided a basis for diagnosis, and virus was isolated and presumptively identified by plaque characteristics. Serum neutralization tests provided positive identification of the agent as IHNV, and electronmicroscopy showed its rhabdovirus morphology. Experimental infections resulted in signs of IHNV and death; test fish had characteristic histopathologic alterations and appropriate virus titers. This is the first completely documented occurrence of IHNV beyond the Pacific Northwest. (Authors)

17238. Douglass, Vaughn M., and Robert T. Lackey (Dept. of Fish. & Wildl. Sci., Va. Polytechnic Inst. and State Univ., Blacksburg, Virginia 24061). 1973. POTENTIAL OF CHANNEL CATFISH PRODUCTION IN VIRGINIA. Reprint from Virginia Journal of Science, 24(2): 89-92.

Research on the feasibility of raising channel catfish (Ictalurus punctatus) in Virginia for supplemental agricultural income was conducted from 1969 to 1971. Results have shown catfish farming to be possible, but various problems must be solved, especially with respect to cage culture. Some conclusions are: (1) the production of marketable channel catfish (>400 g) is economically and biologically feasible; (2) there are existing ponds suitable for commercial catfish production; and (3) under normal conditions and with good management, reasonable returns can be realized. (Authors)

17239. Scherer, Michael D. (Mass. Coop. Fish. Unit, Univ. of Mass., Amherst, Massachusetts). 1973. SOME SKELETAL ANOMALIES IN AMERICAN SHAD (Alosa sapidissima) WITH AN EXAMPLE OF VERTEBRAL CURVATURE IN BLUEBACK HERRING (A. aestivalis). Chesapeake Science, 14(4): 298-300.

17240. Warren, C. E., P. Doudoroff, and D. L. Shumway (Oregon State Univ., Dept. of Fish. & Wildl., Corvallis, Oregon). 1973. DEVELOPMENT OF DISSOLVED OXYGEN CRITERIA FOR FRESHWATER FISH. Environ. Protection Agency, Ecological Research Series Report EPA-R3-73-019, 121 p., available from GPO Sup Doc. as EP1.23:73-019 $2.10; Selected Water Resources Abstracts, 6(18): p. 71.

Research has involved laboratory studies on the survival, development, bioenergetic and growth, swimming performance, and avoidance behavior of chinook and coho salmon, steelhead trout, and largemouth bass. Some studies have been conducted under very simple laboratory conditions, as in aquaria or other apparatus, but some studies on bioenergetics and growth have also been conducted under rather natural conditions in laboratory streams and ponds. In some important cases, close correspondence was found between the effects of reduced oxygen concentration in aquarium studies of growth at maximum rations and its effects under more natural conditions in laboratory streams and ponds. Some of the biological responses of the fish studies were affected by any appreciable reduction in dissolved oxygen below the air saturation levels, whereas others were affected only at levels below about 50 percent the air saturation levels.

17241. Hauser, B. W. (Fish. Res. Bd. of Canada, Freshwater Inst., Winnipeg, Manitoba, Canada). 1973. MODIFICATIONS TO CARLO-ERBA ELEMENTAL ANALYZER FOR RAPID DETERMINATION OF CARBON AND NITROGEN IN SUSPENDED MATTER OF NATURAL WATER. Fish. Res. Bd. of Canada Technical Report No. 412, 10 p., manuscript status.

A Carlo Erba model 1102 analyzer was modified to provide two channels for the determination of carbon and nitrogen in suspended matter filtered from natural water on glass-fiber papers. Details of the instrument modification required, and of the method of operation for analysis of 45-50 samples daily, are given. In routine calibrations with acetanilide as standard, carbon in the range 100-220 μg, and nitrogen in the range 10-30 μg were determined with relative standard deviations of ± 3.6% and ± 5.0%. Replicate analyses of lake water particulate matter, with suspended carbon of 256 μg/paper and nitrogen 23 μg/paper gave actual standard deviations of ± 6.5 μg/paper and ± 3.2 μg/paper respectively. (Auth.)

17242. Ozaki, Hisao, Reiko Akima, and Masayuki Harada (Lab. of Physiol. and Pathol., Tokyo Univ. Fish., Minato-ku, Tokyo 108, Japan). 1973. ON REGENERATION OF SKIN IN CARP. J. Tokyo Univ. Fish., 59(2): 69-78. In Japanese.

In carp with previous removal of some scales, a bit of skin was removed from left body side between lateral line and dorsal fin at the level of anterior end of dorsal fin in the form of square whose sides measure a tenth of body length. Wound areas, expressed in % of initial area, were measured every day and averaged for each experimental group of five fish. With healing, the area first enlarged up to a maximum (maximum dilation of 110 to 150% of initial area 2 to 7 days after the operation), and then reduced to 0% (100% healing 15 to 35 days after), via initial size (restoration to initial area 4 to 10 days after), 50% (50% healing 10 to 15 days after) and 20% of initial area (80% healing 10 to 20 days after). The days from the skin removal to the above critical degrees of healing were graphically found out. The wound of same area healed more quickly in large than in small individuals and at high rather than at low water temperature with the Q_{10} of 2/13. Healing was hurried by repeated injections with thyroxine or macrobin and by feeding in dilute solution of $CuSO_4$, and retarded slightly by injections with cortisol and largely by rearing in dilute $HgCl_2$ solution. Healing mechanisms of the wound are discussed in the light of the knowledge in mammals, that is, cell division inhibitory factor, chalone, adrenaline, diurnal cell division cycle, inhibitory effect of stress, etc. Load of the wound on the fish was considered taking account of poor correlations between specific growth rates of body length or weight and ratios wound area to body length or weight and days to complete healing. It was emphasized that measurement of healing rate of the wound may be a useful means for study on effect of some hormones or especially of some chemical substances faced in water pollution on fish.

17243. Pollard, Herbert A., II, and Ted C. Bjornn (Idaho Fish and Game Dept., Boise, Idaho 83707). 1973. THE EFFECTS OF ANGLING AND HATCHERY TROUT ON THE ABUNDANCE OF JUVENILE STEELHEAD TROUT. Trans. Amer. Fish. Soc., 102(4): 745-752.

We assessed the effects of angling and planted trout on the abundance of wild juvenile steelhead trout in a rearing stream with underwater censusing of abundance and angling for steelhead in sections with and without planted trout. A large proportion of the juvenile steelhead were removed by angling. The presence of hatchery reared, catchable-size rainbow trout did not affect the angling harvest of juvenile steelhead trout. Angling reduced the abundance of juvenile steelhead in the catch-remove study sections but did not alter the numbers of juvenile steelhead in catch-release study sections. Partial recolonization of fished-out areas occurred. Angling was selective for larger juvenile steelhead in the test sections, but had no detectable effect on the average size of fish in subsequent samples because fished-out areas were recolonized by fish of the same size as those originally removed. Differences in fish size and habitat preferences reduced interactions between hatchery rainbow trout and juvenile steelhead trout. Hatchery trout released into study sections slightly altered the distribution of juvenile steelhead trout. (Authors)

17244. Williams, I. V. (New Westminster, British Columbia, Canada). 1973. TESTS WITH NI-FURPIRINOL (P7138) TO CONTROL PRESPAWNING MORTALITIES OF FRASER RIVER SOCKEYE. Intern. Pacific Salmon Fisheries Comm. Progress Report No. 28, 30 p; Fish Health News, 2(4): p. 12.

Ni-Furpirinol (P7138), a nitrofuran compound effective against some fish diseases, was tested for its effectiveness in controlling prespawning mortalities of two races of Fraser River sockeye during 1970. Adult fish captured shortly before spawning were held in 6-ft diameter fiberglass tanks and administered 1 and 3 ppm treatments of Ni-Furpirinol. Experimental results were compared with the natural spawning populations and indicated that Ni-Furpirinol was effective to a degree in controlling Chondrococcus columnaris but did not prevent prespawning deaths of the early fish. An experiment to determine retention time of Ni-Furpirinol in flesh, gonad and skin of both male and female sockeye showed no traces of Ni-Furpirinol 24 hr after a 1 ppm treatment of 1 hr. Although effective in certain respects Ni-Furpirinol is not considered a practical therapeutic agent for prevention of prespawning mortalities of Fraser River sockeye. (Auth.)

17245. Stasko, A. B., R. M. Horrall, A. D. Hasler, and D. Stasko (Limnology Lab., Univ. of Wis., Madison, Wisconsin). 1973. COASTAL MOVEMENTS OF MATURE FRASER RIVER PINK SALMON (Oncorhynchus gorbuscha) AS REVEALED BY ULTRASONIC TRACKING. J. Fish. Res. Bd. Canada, 30(9): 1309-1316.

Eleven mature pink salmon (Oncorhynchus gorbuscha) were tracked in September 1967 for periods of 3-50 hr over distances from 2 to 127 km to determine migration patterns. The fish were classified as "active" or "passive". Active fish moved faster and their paths were straighter. Active tracks ended distant from and to the north (toward the Fraser River) of the release point; passive tracks ended near or south of the release point. Active fish did not follow shorelines, but travelled primarily along the axes of tidal currents. They moved both with the northward flood and against the southward ebb currents, during day and at night. Average ground speed of active fish was 62 cm/sec (2.2 km/hr). (Authors)

17246. Wilson, Robert P. (Dept. of Biochem., Mississippi State Univ., State College, Mississippi). 1973. ABSENCE OF ASCORBIC ACID SYNTHESIS IN CHANNEL CATFISH, Ictalurus punctatus AND BLUE CATFISH, Ictalurus furcatus. Comp. Biochem. Physiol., 46(3B): 635-638.

Ascorbic acid deficiency has been demonstrated in the channel catfish and the symptoms are described. The enzymes involved in ascorbic acid synthesis are apparently lacking in the liver and kidney of both the blue and channel catfish. (Auth.)

17247. Cobb, J. L. S., N. C. Fox, and R. M. Santer (Gatty Mar. Lab., The Univ., St. Andrews, Fife, Scotland). 1973. A SPECIFIC RINGER SOLUTION FOR THE PLAICE (Pleuronectes platessa L.). J. Fish Biol., 5(5): 587-591.

Following analysis of the serum of the blood of the plaice (Pleuronectes platessa L.), a Ringer solution specific for this fish has been devised and tested. It has proved a satisfactory physiological saline for use in electrophysiological experiments and in the preparative procedures for electron microscopy. (Authors)

17248. Islam, Md. Aminul, Yukio Nose, and Fujio Yasuda (Fac. of Fish., Bangladesh Agric. Univ., Mymensingh, Bangladesh). 1973. NUMBER AND DISTRIBUTION PATTERN OF THE BLACK SPOTS ON BODY SURFACE OF RAINBOW TROUT. Extracted from the thesis work of Md. Aminul Islam for Dr. of Agric. in Univ. of Tokyo; Bull. of Jap. Soc. Sci. Fish., 39(7): 727-739. In English.

A survey made on the number and distribution pattern of black spots in some definite areas of the body surface of 1,394 Japanese rainbow trout showed a maximum variation in the number of spots in area B (an area on the chest around the pectoral fin) which was polymodal in nature. Modes were situated at or very close to the same locations in all the hatcheries. Annual variations did not seem to occur in the number of spots in area B which showed inter-hatchery differences. Average number of spots was maximum in Hiruzen where the eggs were of recent introduction from the U. S. under the name of "steelhead". The number was less in Akashina, Okutama and Oizumi while intermediate in Fujinomiya and Nikko. Significant difference was observed in the average number of spots within a particular spawning season. Early spawning group appeared to exhibit higher average number of spots in area B than the mid and late spawning groups in Okutama.

17249. McIntyre, J. D. (Oregon Coop. Fishery Unit, Corvallis, Oregon). 1972. EFFECTS OF METALS ON FERTILIZATION AND DEVELOPMENT IN FISH. In: Heavy Metals in the Environment; Proc. of Seminar conducted by Oregon State Univ., Corvallis, Fall Quarter 1972: Oregon State Univ. Water Resources Res. Inst. Report SEMN WR 016.73, pp. 163-168; Selected Water Resources Abstracts, 6(20): p. 65.

A literature review shows that successful fertilization of fish may be prevented by toxic metals through effects on behavior. In long term studies of the effects of metals on various life history stages of the brook trout, males in exposure levels of 3.4 ppb cadmium were seized by severe muscle spasms as females began to move gravel in redd preparation. These males were generally unsuccessful in fertilizing the eggs and eventually died. Direct effects of metals on gamete survival may prevent successful fertilization. Results of an acute test in which samples of steelhead trout sperm were held in various concentrations of methylmercuric chloride for 30 minutes before they were combined with eggs indicated that at concentrations greater than 1 ppm, sperm viability was markedly reduced. The sexual development of fathead minnows in methylmercury is arrested at 0.25 ppb. Zebra fish that were permitted to spawn in several concentrations of phenylmercuric acetate produced fewer eggs at concentrations of 1 ppb or more as compared to lower concentrations.

17250. Barica, Jan (Fish. Res. Bd. of Canada, Freshwater Inst., Winnipeg, Manitoba R3T 2N6, Canada). 1973. USE OF A SILVER-SULFIDE ELECTRODE FOR STANDARDIZING AQUEOUS SULFIDE SOLUTION IN DETERMINING SULFIDE IN WATER. J. Fish. Res. Bd. Canada, 30(10): 1589-1591.

A simplified method is described for standardizing aqueous sulfide solution in determining sulfide in water. A silver-sulfide electrode is used to detect the endpoint in titration of standard solution of sodium sulfide by silver nitrate. The method makes it possible to perform potentiometric titration within 60 sec by adding the titrant until the potential reading is between -150 and 0 mv, without plotting the data on a graph. The concentrations of sulfide solutions determined by this method were within $\pm$ 0.24 mg S (SD), or 3%, of the values obtained by the conventional iodometric standardization. (Auth.)

17251. Yarzhombek, A. A., and N. V. Maslennikova (All-Union Res. Inst. for Sea Fish. and Oceanogr. (VNIRO), Moscow, USSR). 1972. THE DYNAMICS OF FREE AMINO ACIDS IN THE EMBRYOGENY OF THE SEA TROUT [Salmo trutta (L.)] AND THE BELUGA [Huso huso (L.)]. J. Ichthyol., 12(5): 868-871.

The dynamics of the excretion of nitrogenous metabolites correlates in beluga embryos and larvae with their total content of free amino acids. The dynamics of the excretion of nitrogenous metabolites correlates in sea trout embryos with the content of free aspartic and glutamic acids in their eggs. (Authors' conclusions)

17252. Pessah, E., J. S. Loch, and J. C. MacLeod (Fish. Res. and Develop. Directorate, Freshwater Inst., Winnipeg, Manitoba, Canada). 1973. PRELIMINARY REPORT ON THE ACUTE TOXICITY OF CANADIAN PETROLEUM REFINERY EFFLUENTS TO FISH. Fish. Res. Bd. of Canada Technical Report No. 408, 43 p. Manuscript status.

Two refineries in Canada were found whose effluents did not kill rainbow trout in standard 96 hr. flow-through bioassays and which appear to utilize sound waste treatment practices. Formulated "effluent" based upon concentrations of toxicants identified by E.P.S. as being attainable by best practicable waste treatment did not kill rainbow trout in the standard flow-through bioassay. Therefore, Canadian oil refineries employing sound waste treatment, including good housekeeping, can produce effluents which are not acutely toxic. Since repetitive sampling of a single effluent was not within the scope of this study, it is not possible to determine the frequency with which Canadian oil refineries can produce effluents which are not acutely toxic. (Authors' conclusions)

17253. Davies, Robert B., Walter T. Burkhard, and Charles P. Hibler (Wild. Animal Dis. Center, Colorado State Univ., Fort Collins, Colorado). 1973. DIPLOSTOMOSIS IN NORTH PARK, COLORADO. Journal of Wildlife Diseases, 9(4): 362-367.

The life cycle of Diplostomum spathaceum (Rudolfi 1819), as it exists in North Park, Colorado, is elucidated. California gulls (Larus californicus), common mergansers (Mergus merganser) and Forster's terns (Sterna forsteri) act as definitive hosts. Two species of water snails, Physa gyrina and Lymneae elodes, act as first intermediate hosts with seven species of fish as second intermediate hosts: brassy minnows (Hybognathus hankinsoni), brook trout (Salvelinus fontinalis), brown trout (Salmo trutta), mackinaw (Salvelinus namaycush), rainbow trout (Salmo gairdneri), western long nose suckers (Catostomus catostomus) and western white suckers (C. commersoni). Infection of fish by larvae of D. spathaceum results in cataracts of the lens and impaired vision. (Authors)

17254. Seamans, Richard G., Jr., and Arthur E. Newell, Jr. 1973. MANAGEMENT OF LAKE ATLANTIC SALMON (Salmo salar) IN NEW HAMPSHIRE. New Hampshire Fish and Game Dept. Survey Report No. 10, 92 p., illus.

Text includes: Acknowledgements...Introduction...History of Lake Atlantic Salmon in New Hampshire...Experimental Management, Winnipesaukee Lake... Description of the lake; Experimental techniques; Evaluation of Stocking procedures; Evaluation of the fishery; Lake ecology of hatchery reared salmon. Experimental Management, Winnisquam Lake...Description of the lake; Experimental techniques; Evaluation of stocking procedures; Evaluation of the fishery; Lake ecology of hatchery reared salmon. General Management Considerations...Ice fishing; Economic implications of salmon fisheries. General Discussion...Literature cited. (From Table of Contents)

17255. Wydoski, R. S. 1972. ANNOTATED BIBLIOGRAPHY ON THE ECOLOGY OF THE LAKE WASHINGTON DRAINAGE. U. S. Int. Biol. Program, Ecosystems Analysis Studies, Coniferous Forest Biome, Bull. No. 1, 102 p.

This bibliography contains 392 published and unpublished references that pertain to the ecology of the Lake Washington watershed, with particular reference on the aquatic environment.

17256. Nagiec, Maria (Wyzsza Szkola Rolnicza w Olsztynie, Inst. Rybactwa Srodladowego, Poland). 1973. THE FOOD CONSUMPTION OF THE THREE YEAR OLD PIKE-PERCH (Lucioperca lucioperca (Linnaeus 1758)) FROM THE JEZIORAK LAKE IN THE MAZURIAN LAKE DISTRICT. [Zapotrzebowanie na pokarm trzyletniego sandacza (Lucioperca lucioperca (Linnaeus 1758) w jeziorze jeziorak]. Roczniki Nauk Rolniczyc, 95(2): 43-53. In Polish with English synopsis.

Estimation of feeding rate of a pike-perch three years old performed on the basis of daily ration of food consumed, was calculated by the rate of food passage. Estimation was made of food consumption quantities on the basis of daily rations. The estimation proved to be almost similar to that obtained by Vinberg's method. (Auth. synopsis)

17257. Yamane, Shinichi (Dept. of Fish., Fac. of Agric., Miyazaki Univ., Miyazaki, Japan). 1973. LOCALIZATION OF AMYLASE ACTIVITY IN DIGESTIVE ORGANS OF CARP DETERMINED BY A SUBSTRATE FILM METHOD. Bull. Jap. Soc. Sci. Fish., 39(5): 497-504. In English.

The digestive organs of carp were examined histochemically by a substrate film method, instead of the tissue homogenization procedure hitherto used in studying this subject. In the carp, amylase activity was detected in the cytoplasm of the acinous cells of the pancreas, on the luminal surfaces of the pharynx and the intestinal bulb, and on the outside of the muscularis and serosa of the intestinal bulb. The presence of amylase in the cytoplasm of the pancreatic acinous cells suggests that these are the center of amylase production in the carp, exclusive of the mucosa of the digestive tract and the hepatic cells. Amylase on the luminal surface of the digestive tract is certainly secreted from the pancreas. Amylase on the outside of the tract may derive from the pancreatic ramification adhering to the tract. (Auth.)

17258. Glooschenko, W. A., and J. E. Moore (Great Lakes Biolimnol. Lab., Fish. and Marine Service, Centre for Inland Waters, Burlington, Ontario, Canada). 1973. SURFACE DISTRIBUTION OF CHLOROPHYLL a AND PRIMARY PRODUCTION IN LAKE HURON, 1971. Fish. Res. Bd. of Canada Technical Report No. 406, 4 p. + figs. + tabs. Manuscript status.

During the period April-December, 1971, chlorophyll a and primary production measurements were made on 8 cruises on Lake Huron. The highest chlorophyll a and production values were measured in Saginaw Bay, with respective ranges of 7.8 - 37.5 mg/m^3 and 4.1 - 158.4 $mgC/m^3/hr$. In the main portion of the lake, chlorophyll a ranged from 0.0 - 12.0 mg/m^3 while primary production values up to 21.6 $mgC/m^3/hr$ were measured. Higher values of both chlorophyll a and primary production generally occurred in inshore waters along the southern half of the lake, both on the Michigan and Ontario shores, while the northern half of the lakes is low in these two parameters. Other than highly eutrophic Saginaw Bay, the rest of the lake appears to be classified as oligotrophic. (Authors)

17259. Thompson, B. M., and R. D. Hamilton (Dept. of Microbiol., Univ. of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada). 1973. HETEROTROPHIC UTILIZATION OF SUCROSE IN AN ARTIFICIALLY ENRICHED LAKE. J. Fish. Res. Bd. Canada, 30(10): 1547-1553.

Utilization of sucrose by heterotrophic microorganisms was measured in a small lake enriched with 5.54 g C/m^2 per year as sucrose. Heterotrophic activity exhibited fluctuations representing the damped oscillations of a disturbed steady state system, stabilizing 3 months after the commencement of enrichment. By late summer, reduction of the weekly addition of sucrose to a few micrograms per liter was accomplished within a day by the increased microbial activity resulting from rapid growth of heterotrophic microorganisms. Heterotrophic conversion (preenrichment) of sucrose to particulate carbon in the epilimnion between July and October 1971 was 2-17% of primary production. 25-35% of total sucrose utilized was converted to carbon dioxide, the remainder being incorporated into particulate material or released as nonvolatile products of metabolism. (Authors)

17260. Nicola, Stephen J., and Almo J. Cordone (Calif. Dept. of Fish and Game, Sacramento, Calif. 95814). 1973. EFFECTS OF FIN REMOVAL ON SURVIVAL AND GROWTH OF RAINBOW TROUT (Salmo gairdneri) IN A NATURAL ENVIRONMENT. Trans. Amer. Fish. Soc., 102(4): 753-758.

The long-term survival of fin-clipped and unmarked rainbow trout was studied in Castle Lake, California. The results of this study confirmed the generally held belief among fishery workers that fin removal has a serious detrimental effect on fingerling salmonids. Moreover, the relative magnitude of this effect for each of the seven fins that could be removed was determined; viz.: (1) removal of the adipose fin may reduce survival by as much as 50%, (2) removal of a ventral fin may reduce survival by as much as 60 to 70%, (3) removal of a pectoral or dorsal fin may reduce survival by as much as 70 to 80%, and (4) removal of the anal fin may be no worse than removal of the pectoral or dorsal fins, but can have an inconsistent effect. The absence of a single fin did not reduce significantly the rate of growth of the members of a group possessing that mark. (Authors)

17261. Tesarcik, J., and J. Rehulka. 1973. THE Hexamita salmonis INVASION OF THE AIR BLADDER OF AMERICAN RAINBOW TROUT. (Invaze Hexamita salmonis v plynovem mechyri pstruhu americkych duhovych). Bul, VUR Vodnany IX (Jan.-Mar.): 25-27; Fish Health News, 2(4): p. 11.

The inflammation of the air bladder of American rainbow trout was first diagnosed in Czechoslovakia in the year 1970. Among the many cases of occurrence, it was only in a single case of a sexually mature female fish that Hexamita salmonis acted as one of the causative agents etiologically contributing to the chronical changes in air bladder. (Authors' summ.)

17262. Ikeda, Yayoi, Hisao Ozaki, Eizaburo Uenishi, and Kazuo Uematsu (Radioisotope Res. Lab., Tokyo Univ. Fish., Minato-ku, Tokyo 108, Japan). 1973. PRICE-JONES CURVE IN CULTURED YELLOWTAIL. J. Tokyo Univ. Fish., 59(2): 79-89. In Japanese with English abstract.

Authors drew the Price-Jones curves of erythrocyte in yellowtail (Seriola quinqueradiata) fed on raw fish meal, basal compound diet, and compound diets with added various amounts of iron, and compared the pattern of the curve due to different diets as well as according to the growth. In so-called normal yellowtail fed on raw fish meal, physiological range of erythrocytes according to their major diameter was indicated as follows: normocyte 9 to 10.5 μ, microcyte 7 to 9 μ, and macrocyte 10.5 to 12 μ. Diurnal variations in the Price-Jones curves were observed in the fish fed on raw fish meal and compound diet. Major diameter trended longer in night than in day. Erythrocytes increased from 6 to 12 μ in an average size according to growth of the fish fed on raw fish meal. Erythrocytes showed rather microcytotic and anisocytotic in the initial growth phase of July to August and subsequently normocytotic and isocytotic. Erythrocytes of the fish fed on compound diet with 1% McCollum salt mixture added for one month changed to microcytotic and anisocytotic. Erythrocytes of the fish fed on iron deficient compound diet for the same period changed more quickly and clearly microcytotic, and also anisocytotic than those on the compound diet with 1% McCollum salt mixture added. On the contrary, those fed on the compound diet with 57.3 mg% of iron added revealed almost the same Price-Jones curves as those of normal fish. These findings suggest that the Price-Jones curve itself transforms quantitatively depending on iron content in diet, therefore it may be a convenient index to diagnose anemia, especially resulting from iron-deficiency.

17263. Morgan, Raymond P. II (Chesapeake Biol. Lab., Nat. Res. Inst., Univ. of Maryland, Solomons, Maryland). 1973. MARKING FISH EGGS WITH BIOLOGICAL STAINS. Chesapeake Science, 14(4): 303-305.

Thirty biological stains were tested on winter flounder (Pseudopleuronectes americanus) and striped bass (Morone saxitilis) eggs. Azure A, Fast Green FCF, Janus Green B, Nile Blue, Rose Bengal, Toluidine Blue O, and Trypan Blue were excellent in staining ability, and all except Nile Blue were excellent in stain retention. All seven are considered suitable for tagging fish eggs.

17264. Dryfoos, Robert L., Randall P. Cheek, and Richard L. Kroger (Atlantic Estuarine Fish. Center, NMFS, NOAA, Beaufort, North Carolina 28516). 1973. PRELIMINARY ANALYSES OF ATLANTIC MENHADEN, Brevoortia tyrannus, MIGRATIONS, POPULATION STRUCTURE, SURVIVAL AND EXPLOITATION RATES, AND AVAILABILITY AS INDICATED FROM TAG RETURNS. U. S. Dept. of Comm., NOAA Fish. Bull., 71(3): 719-734.

Over 1 million adult Atlantic menhaden, Brevoortia tyrannus, were tagged from Long Island Sound to Florida between 1966 and 1969. Tag recoveries indicate these fish migrated northward in spring and early summer and southward in fall. As the fish grew older and larger, they also migrated farther northward each spring. Calculation of rates of interchange between fishing areas indicated that 21% of the recoveries from fish released in Chesapeake Bay in 1967 and 1968 accounted for 72% of the catch of tagged fish 1 yr later in New York and New Jersey. Preliminary estimates of population parameters were made from tag-recovery and catch data. Survival rates determined yearly from ratio of recoveries, however, varied due to fluctuations in availability. Annual survival rates averaging 0.23 were calculated with Robson-Chapman catch curve analysis and age composition of catch methods. From tag recoveries, exploitation rate was estimated to be 50%, instantaneous fishing mortality rate (F) was 0.95, and instantaneous natural mortality (M) was 0.52. Tag returns also indicated that significant fluctuations in availability of Atlantic menhaden occurred in Chesapeake Bay. (Authors)

17265. Gratzek, John B., Merrill H. McGlamery, Donald L. Dawe, and Trudy Scott (Dept. of Medical Microbiol., Coll. of Vet. Medicine, Univ. of Georgia, Athens, Georgia 30602). 1973. MICROCULTURES OF BROWN BULLHEAD (Ictalurus nebulosus) CELLS: THEIR USE IN QUANTITATION OF CHANNEL CATFISH (Ictalurus punctatus) VIRUS AND ANTIBODY. J. Fish. Res. Bd. Canada, 30(11): 1641-1645.

A microculture system was applied to the culture of brown bullhead (Ictalurus nebulosus) cells and used for the titration of channel catfish (Ictalurus punctatus) virus and corresponding antibody. As few as 1.7×10^4 cells/well could be used for routine titrations. Simultaneous inoculation of virus cells at the time of planting resulted in clearer endpoints as opposed to inoculation of preformed monolayers. When channel catfish virus antibodies were measured using plaque reduction and microculture titration assays as indicator systems, no significant differences in antibody titers were noted. (Authors)

17266. Hashagen, Kenneth A., Jr. 1973. POPULATION STRUCTURE CHANGES AND YIELDS OF FISHES DURING THE INITIAL EIGHT YEARS OF IMPOUNDMENT OF A WARMWATER RESERVOIR. Calif. Fish and Game, 59(4): 221-244.

Data from creel census and netting programs were used to study changes in the relative abundance, age, and species composition of fish during the first 8 years of impoundment of Merle Collins Reservoir, Yuba County, California. The effects of the changes of fish yields are discussed. High survival of the first (1964) year class of largemouth bass (Micropterus salmoides) produced a large population of slow growing bass that dominated the fishery through 1967. These fish limited survival and recruitment of all centrarchids in 1965 and 1966 and depressed initial yields. Largemouth bass and green sunfish (Lepomis cyanellus) declined numerically after 1968. Bluegill (L. macrochirus) and redear sunfish (L. microlophus) increased dramatically. Catfish remained stable and were probably underexploited. Salmonids, introduced in late 1966, increased total pressure and effort and raised annual yields. Age composition of centrarchids changed from adult fish and fish of the initial year class to a structure in which several year classes and all sizes were represented by the end of the 8-year study. Anticipated changes in species composition failed to develop as numbers of nongame species remained extremely low throughout the study. High initial yields customarily associated with new impoundments were not obtained. Yields ranged from 2.3 to 10.7 lb/acre. (Auth.)

17267. Barr, Louis, and James R. Knull (NMFS, Auke Bay Fish. Lab., Auke Bay, Alaska 99821). 1973. A TEMPORARILY ANOXIC WATER MASS IN AN ALASKA ESTUARY. U.S. Dept. of Comm., NOAA Fish. Bull., 71(3): 896-900.

17268. Swenson, William A., and Lloyd L. Smith, Jr. (Dept. of Entomol., Fish., and Wildl., Univ. of Minnesota, St. Paul, Minn.). 1973. GASTRIC DIGESTION, FOOD CONSUMPTION, FEEDING PERIODICITY, AND FOOD CONVERSION EFFICIENCY IN WALLEYE (Stizostedion vitreum vitreum). J. Fish. Res. Bd. Canada, 30(9): 1327-1336.

Gastric digestion of walleye, Stizostedion vitreum vitreum, and sauger, Stizostedion canadense, was measured by pumping stomachs at various intervals after experimental meals had been force-fed or voluntarily consumed. No significant differences in digestion rates were found between species or among walleye taken from three lakes. Repeated use of fish in digestion experiments failed to influence results. Gastric digestion rate increased with fish size, but was depressed by increased meal size, food particle size, and by force-feeding experimental meals. Food consumption rate and feeding chronology of the strong 1966 year-class of Lake of the Woods walleye were determined by applying results of laboratory digestion studies to stomach samples. An estimating technique that takes into account the effects of factors shown to influence digestion in the laboratory was developed and used to make calculations for the field population. Consumption averaged 1% of body weight during June, 2% during July and 3% during August and September. Average temperatures were similar during June and September. Greater consumption during September resulted from higher food availability. Feeding was greatest during night and early morning hours in all months except June when it was continuous. Conversion efficiency of the 1966 year-class was described from estimates of growth and consumption rates for June through September and approximated 20% during each month. (Authors)

17269. Butler, R. L., E. L. Cooper, D. C. Hales, C. C. Wagner, and W. G. Kimmel (Dept. of Biol., Penn. State Univ., University Park, Pennsylvania). 1973. FISH AND FOOD ORGANISMS IN ACID MINE WATERS OF PENNSYLVANIA. Environ. Protection Agency Report EPA-R3-73-032, 158 p., available from GPO Sup. Doc. as EP1.23: 73-032 $2.10; Selected Water Resources Abstracts, 6(18): p. 71.

Objectives were: (1) develop a rapid and non-lethal bioassay for acid water using changes in utilization of cover and activity of fish, (2) determine the effect of different levels of acid mine drainage on the presence or absence of fish populations in the watersheds of Pennsylvania, (3) determine the median tolerance limits to low levels of pH of five aquatic insects chosen on the basis of their wide occurrence and common association in soft-water streams. Analysis of variance revealed there was no relationship between cover utilization and pH levels or between activity and pH levels for four species of fish (smallmouth bass, longnose dace, rock bass and brook trout). In part II of the project it was found that common fish species, normally distributed over several watersheds, were absent where there was severe acid mine drainage. Of the 116 species of fishes found 10 species exhibited some tolerance to acid mine drainage (values of pH 5.5 or less). In part III all aquatic species survived exposure for four days to pH levels from 6.5 to 4.0. The 96-hour TLM values ranged from 3.31 for the most sensitive animal, Stenonema sp., to 1.72 for the most tolerant insect, Nigronia fasciata.

17270. Crawshaw, L. I., and H. T. Hammel (Physiological Res. Lab., Scripps Inst. of Oceanogr., Univ. of California, San Diego, La Jolla, Calif. 92037). 1974. BEHAVIORAL REGULATION OF INTERNAL TEMPERATURE IN THE BROWN BULLHEAD, Ictalurus nebulosus. Comp. Biochem. Physiol., 47(1A): 51-60.

After a period of training, the teleost fish Ictalurus nebulosus, maintained its body temperature at about 26°C when placed in a thermal gradient with extremes of 9 and 30°C. If the rostal brainstem temperature was increased by successive amounts, I. nebulosus regulated at proportionally lower internal body temperatures. When the brainstem temperature was lowered to 10°C, the fish sometimes selected the coldest portion of the gradient and became torpid. Mild brainstem warming caused these fish to return to the warmer portions of the gradient. (Authors)

17271. Wuensche, J., and Marie Luise Albrecht (Forschungszent. Tierprod. Dummerstorf-Rostock, Dtsch. Akad. Landwirtschaftswiss, Berlin, Dummerstorf/Rostock, East Germany). 1973. COMPOSITION OF AMINO ACIDS IN PROTEINS OF DRY MIXED FEEDS FED TO CARP (Cyprinus carpio) AND TROUT (Salmo gairdneri). Chemical Abstracts, 78(9): 56816y; Marine Fish. Abstracts, 26(12) p. 30.

17272. Adron, J. W., P. T. Grant, and C. B. Cowey (Inst. of Marine Biochem., Aberdeen, Scotland). 1973. A SYSTEM FOR THE QUANTITATIVE STUDY OF THE LEARNING CAPACITY OF RAINBOW TROUT AND ITS APPLICATION TO THE STUDY OF FOOD PREFERENCES AND BEHAVIOR. J. Fish Biol., 5(5): 625-636.

A system for the quantitative study of the learning capacity of rainbow trout and its application to the study of food preferences and of behavior. Groups of trout were self-trained in about 10 days to actuate a trigger and feed themselves. This capacity was retained for 3 months without the stimulus of continuous reinforcement. Presented with a choice, conditioned populations showed a high degree of discriminatory ability towards a trigger that supplies food and one that does not. The choice system was used to examine preferences for the taste of pelleted foods. A trained population, under continuous illumination developed a feeding rhythm that occurred about every 8 h. (Authors)

17273. Schindler, D. W., and E. J. Fee (Fish. Res. Bd. of Canada, Freshwater Inst., Winnipeg, Manitoba R3T 2N6, Canada). 1973. DIURNAL VARIATION OF DISSOLVED INORGANIC CARBON AND ITS USE IN ESTIMATING PRIMARY PRODUCTION AND CO_2 INVASION IN LAKE 227. J. Fish. Res. Bd. Canada, 30(10): 1501-1510.

Standard in situ measurements of phytoplankton production and ^{14}C bottle bioassays gave erroneous results when applied to lake 227, a eutrophic softwater lake in the Canadian Shield. Errors were found to be due to diurnal variations in the degree of carbon limitation of phytoplankton, and to invasion of CO_2 from the atmosphere and hypolimnion. A method based on diurnal measurements of dissolved inorganic carbon, community respiration, and invasion of CO_2, using gas chromatography, is described. Production by phytoplankton in lakes fertilized with nitrogen and phosphorus was found to be several times higher than in natural lakes of the area. Net production during summer stratification was found to equal invasion of CO_2 from the atmosphere. The new technique should have application in other eutrophic low carbon lakes, where ^{14}C tracer techniques are encumbered by serious technical complications. (Authors)

17274. Willford, W. A., R. J. Hesselberg, and H. L. Bergman (Great Lakes Fish. Lab., NMFS, Ann Arbor, Michigan). 1973. VERSATILE COMBUSTION-AMALGAMATION TECHNIQUE FOR THE PHOTOMETRIC DETERMINATION OF MERCURY IN FISH AND ENVIRONMENTAL SAMPLES. Journal of the Association of Official Analytical Chemists, 56(4): 1008-1014; Selected Water Resources Abstracts, 6(23): p. 42.

Total mercury in a variety of substances is determined rapidly and precisely by direct sample combustion, collection of released mercury by amalgamation, and photometric measurement of mercury volatilized from the heated amalgam. Up to 0.2 g fish tissue is heated in a stream of 02 (1.2 l/min) for 3.5 min in 1 tube of a 2-tube induction furnace. The released mercury vapor and combustion products are carried by the stream of 02 through a series of traps (6 percent NaOH scrubber, water condenser, and Mg (C104)2 drying tube) and the mercury is collected in a 10 mm diameter column of 24 gauge gold wire (8 g) cut into 3 mm lengths. The resulting amalgam is heated in the second tube of the induction furnace and the volatilized mercury is measured with a mercury vapor meter equipped with a recorder-integrator. Total analysis time is approximately 8 min/sample. The detection limit is less than 0.002 microgram and the system is easily converted for use with other biological materials, water, and sediments. Major advantages of the method include: simplicity of operation; speed of complete analysis; high sensitivity, precision, and accuracy; small sample size required; freedom from rigorous and sometimes hazardous acid-digestion procedures; freedom from reagent and glassware contamination; and comparatively low cost of equipment. Disadvantages of the method include: somewhat limited usable range of sensitivity (0.02-5.0 ppm); a general inability to analyze highly contaminated samples (greater than 5.0 ppm) without the use of a gas stream splitter or an extremely small sample; necessity for frequent changes in attenuation of mercury vapor meter, unless previous knowledge permits grouping of samples within ranges having less

than a 5-fold difference in concentration; and increased emphasis on the need for well homogenized representative samples. Minor changes in the system or substitution of a less sensitive mercury vapor meter would overcome many of these disadvantages when they are restrictive for a particular use.

17275. Ahling, B., and A. Jernelov (Inst. Vatten- och Luftvärdsforskning, Drottning Kristinas Väg 47, 11428 Stockholm, Sweden). 1971. WEED CONTROL WITH GRASS CARP IN LAKE ÖSBYSJÖN. Swedish Water and Air Pollution Research Laboratory, No. B 94a, 24 pp; Weed Abstracts, 22(8): No. 1703.

In 1969 Myriophyllum verticillatum in Lake Ösbysjön (area 46,000 m^2) amounted to 16 t d.m. In May 1970 250 grass carp (Ctenopharyngodon idella), with an average wt. of 380 g, were introduced into the lake. After about 100 days their average wt. was 1,030 g. Myriophyllum had decreased to 7.3 t (d.m.) by the end of summer 1970. Physico-chemical studies showed a temporary increase in the phosphate phosphorous content of the lake during summer 1970 and an improved O_2 situation during winter 1970-71. No significant changes were observed in the phytoplankton. Among zooplankton there was an appreciable reduction in ciliates, indicating a decrease in bacteria. For zoobenthos there was a tendency towards more typical clean-water organisms in summer and a general increase in organisms in winter.

17276. Moore, Richard H. (Univ. of Texas, Marine Science Inst., Port Aransas, Texas 78373). 1973. THE EFFECT OF TEMPERATURE AND SWIMMING SPEED ON THE OXYGEN CONSUMPTION OF TWO SNAPPERS, Lutjanus campechanus (Poey) AND Rhomboplites aurorubens (Cuvier). Contributions in Marine Science, 17: 53-61.

Respiratory rates and swimming speeds of red snapper, Lutjanus campechanus (Poey), and vermilion snapper, Rhomboplites aurorubens (Cuvier), were determined at 12.5°, 18°, and 27.5°C. The relationship of oxygen consumption to temperature is similar to that found in other fish species with values at 18° of 112 and 70 mg/kg/hr for red and vermilion snapper, respectively. Maximum sustained swimming speed and "scope for activity" show similar relationships to temperature for each species; however, the differences in "scope" between the two species probably have zoogeographical and ecological importance. The cold-lethal temperature of vermilion snapper is estimated to be not far below 12.5° during the spring months. For red snapper the cold-lethal temperature is undoubtably somewhat lower. (Auth.)

17277. Tilly, L. J. (Savannah River Lab., E. I. duPont de Nemours & Company, Aiken, South Carolina). 1973. COMPARATIVE PRODUCTIVITY OF FOUR CAROLINA LAKES. The Amer. Midl. Nat., 90(2): 356-365.

Field data for ^{14}C uptake in two reservoirs, a Carolina bay and an oxbow in South Carolina indicate that lakes of this region are low in primary productivity compared to lakes elsewhere for which published values are available. Par Pond, a reactor-cooling reservoir, is the only lake studied which shows even moderate productivity. Factors which may be related to productivity in these lakes include nutrient level, water temperature, light penetration as influenced by turbidity and water color, and stratification as influenced by local topography and lake morphometry. Limnological characteristics of the four South Carolina lakes are summarized. (Auth.)

17278. Krogius, F. V. (TINRO, Petropavlovsk-Kamchatskij, USSR). 1973. POPULATION DYNAMICS OF GROWTH OF YOUNG SOCKEYE SALMON IN LAKE DALNEE. Hydrobiologia, 43(1-2): 45-51.

Three periods sharply differing in the state of the ecosystem were observed in Lake Dalnee over the period of 30 years. 1. Different abundance of sockeye salmon, three-spined stickleback and predacious char; 2. Appearance and disappearance of a four-year periodicity in the abundance fluctuations; 3. Different proportions of one-, two- and three-year old fish migrating to sea and the number of residuals; (Changes in the first and second trophic levels and in biogenic content in the water took place). Disturbances in one link of the ecosystem resulted in serious long-term changes in the whole system. Such change of dynamic equilibrium may become irreversible. (Auth.)

17279. Beamish, F. W. H. (Dept. of Zool., Univ. of Guelph, Guelph, Ontario, Canada). 1973. OXYGEN CONSUMPTION OF ADULT Petromyzon marinus IN RELATION TO BODY WEIGHT AND TEMPERATURE. J. Fish. Res. Bd. Canada, 30(9): 1367-1370.

The logarithm of standard oxygen consumption of adult Petromyzon marinus increased linearly with the logarithm of weight at each of 5, 10, and 15 C. The proportionate change in standard oxygen consumption for a given change in temperature was independent of size, the mean regression coefficient being 0.949. Standard oxygen consumption for a sea lamprey of fixed weight increased from 52.7 to 124.0 mg/kg per hr over the range 5-20 C with the greatest changes occurring between 10-15 C, 64.5-114.3 mg/kg per hr. Active oxygen consumption was estimated for a few individuals at 10 C and found to be 475.5 mg/kg per hr, within the range reported for teleosts. (Auth.)

17280. Ikeda, Yayoi, Hisao Ozaki, and Kazuo Uematsu (Radioisotope Res. Lab., Tokyo Univ. Fish., Minato-ku, Tokyo 108, Japan). 1973. EFFECT OF ENRICHED DIET WITH IRON IN CULTURE OF YELLOWTAIL. J. Tokyo Univ. Fish., 59(2): 91-99. In Japanese with English abstract.

Authors studied the effects of iron on the anemia of yellowtail (Seriola quinqueradiata) fed on raw fish, compound diet with 7.3 mg% of iron added, and compound diet with 57.3 mg% of iron added, from July to December, 1970. The decreasing orders of body weight, erythrocyte count, hemoglobin level, color index and serum protein level after feeding of about 4 months, were raw fish group $>$ compound diet with 57.3 mg% of iron added group $>$ compound diet with 7.3 mg% of iron added group. Although decreasing orders of liver, kidney, spleen and heart weight were compound diet with 7.3 mg% of iron added group $>$ compound diet with 57.3 mg% of iron added group $>$ raw fish group, the effect of iron enrichment was not observed on the digestive organs. Serum iron level was the highest in diet with 57.3 mg% of iron added group, and the lowest in diet with 7.3 mg% of iron added group. To the contrary, absorption of ^{59}Fe was the highest in diet with 7.3 mg% of iron added group and the lowest in group fed on diet with 57.3 mg% of iron added group. Those fed on diet enriched with iron revealed almost the same Price-Jones curve as that of the fish fed on raw fish. Based on the above data, iron added to the compound diet in culture of yellowtail was sufficient at 57.3 mg%.

17281. Eddy, F. B. (Res. Unit for Comparative Animal Respiration, Univ. of Bristol, Bristol BS8 1UG, England). 1974. In vitro BLOOD CARBON DIOXIDE OF THE RAINBOW TROUT (Salmo gairdneri). Comp. Biochem. Physiol., 47(1A): 129-140.

Rainbow trout were acclimated to 6, 15 and 20°C for at least 3 weeks; blood was removed and equilibrated in vitro at the acclimation temperature with CO_2 tensions in the range 1-8 mm Hg. Determinations of blood carbon dioxide content and pH were made. Increasing temperature caused a decrease in blood pH and CO_2 content, but the buffering capacity ($\Delta C_{CO_2}/\Delta$ pH) appeared to be the same at all temperatures. Oxygenated blood contained less carbon dioxide than deoxygenated blood - the Haldane effect; this effect appeared to increase with decreasing temperature. The buffering properties of trout blood are compared with those of other species. The acid-base status of the blood is discussed in terms of the Henderson-Hasselbalch equation and the concept of relative alkalinity. (Auth.)

17282. Tatum, Walter M. (Ala. Dept. of Conserv. and Nat. Resources, Marine Resources Div., Dauphin Island, Alabama 36528). 1973. BRACKISH WATER CAGE CULTURE OF RAINBOW TROUT (Salmo gairdneri), IN SOUTH ALABAMA. Trans. Amer. Fish. Soc., 102(4): 826-828.

Experiments in the brackish water culture of rainbow trout (Salmo gairdneri), were conducted from 25 November 1971 to 24 March 1972 to determine the feasibility of providing a supplemental cash crop in the coastal water of Alabama during the winter. During this period trout were raised from an initial weight of 93.8 g to 354.8 g when stocked at 196 fish/m^3 and 322.3 g when stocked at 392 fish/m^3. Rainbow trout acclimated easily to brackish water and their potential to southern mariculture appears promising. (Auth.)

17283. Sutherland, Doyle F. (Northwest Fish. Center, NMFS, NOAA, Seattle, Washington 98112). 1973. DISTRIBUTION, SEASONAL ABUNDANCE, AND SOME BIOLOGICAL FEATURES OF STEELHEAD TROUT, Salmo gairdneri, IN THE NORTH PACIFIC OCEAN. U. S. Dept. of Comm., NOAA Fish. Bull., 71(3): 787-826.

Cruise and catch data of Canadian, Japanese, and United States research vessels for 1953 and 1955-67, together with information from published literature, were used to investigate the distribution, age, and size of steelhead trout, Salmo gairdneri, in the North Pacific Ocean. Steelhead trout were distributed virtually throughout the entire North Pacific Ocean, north of about lat. 42°N. Their abundance was greatest in the Gulf of Alaska and eastern North western Aleutian Islands area. The relative abundance in all areas sampled was far less than that of Pacific salmon, Oncorhynchus spp. The distribution of steelhead trout at sea appears to be influenced by surface water temperatures, apparently conforming closely to the 5°C isotherm on the north and the 15°C isotherm on the south. Definite seasonal shifts of abundance were associated with changes in water temperature. Northward and westward movement began in late winter and early spring and became most extensive in summer; it shifted to a southward and eastward movement in late summer, fall, and early winter. Ages of steelhead trout caught at sea ranged from 2 to 8 yr. The majority of fish were 3, 4, or 5 yr old and belonged to either the 2.1, 3.1, or 3.2 age groups. The length of time spent in salt water had a marked effect on size of fish. In their first summer in the ocean, they grew in average size from about 15 to 36 cm in length and to 0.8 kg in weight. At the end of the first year at sea (age .0 to .1), their average size was 57 cm and 2 kg; in the second year (age .1 to .2), it was 70 cm and 3 kg. (Auth.)

17284. Wolf, Ken (Eastern Fish Disease Lab., Bur. of Sport Fish. & Wildl., Kearneysville, West Virginia). 1973. FRESHWATER FISHES. In: Tissue Culture. Methods and applications. Academic Press, N. Y., Chap. 23, pp. 138-144; Fish Health News, 2(4): p. 12.

The chapter is a brief resume of procedures for preparing primary monolayer cell cultures from freshwater fishes. Procedures include direct planting of minced tissues, trypsinization of minced tissues, and culture methods for fish leucocytes. (Auth.)

17285. Tinsley, Ian J., Hugo M. Krueger, and James B. Saddler (Dept. of Agric. Chem. and of Fish. and Wildl., Oregon State Univ., Corvallis, Oregon 97331). 1973. FATTY ACID CONTENT OF COHO SALMON, Oncorhynchus kisutch - A STATISTICAL APPROACH TO CHANGES PRODUCED BY DIET. J. Fish. Res. Bd. Canada, 30(11): 1661-1666.

Stepwise multiple regression procedures have been used to develop equations expressing the fatty acid content of fingerling coho salmon, Oncorhynchus kisutch, as a function of fish length and the time the salmon had been maintained in the laboratory on a specific diet. High correlation coefficients from the multiple regressions were obtained for most of the fatty acids studied and from the derived equations the fatty acid content of individual fish could be predicted with a fair degree of precision. Under the specified experimental conditions changes in wet weight, the total mass of fatty acids per salmon, and the mass of most individual fatty acids per salmon were dependent on the time in the laboratory and on the product (interaction) of time in laboratory with length of the salmon. At 8-cm length body weight was increasing 30 mg daily and the fatty acid content 7.3 mg daily. A detailed analysis is presented for several fatty acids whose predicting equations are representative of the different relationships observed. A case is presented for the unique role of fatty acid 22:6 in fish. (Authors)

17286. Van Cleve, Richard, and Donald E. Bevan (College of Fish., Univ. of Washington, Seattle, Wash. 98195). 1973. REPLY TO ROUNSEFELL'S "COMMENTS ON 'EVALUATION OF CAUSES FOR THE DECLINE OF THE KARLUK SOCKEYE SALMON RUNS AND RECOMMENDATIONS FOR REHABILITATION,' BY R. VAN CLEVE AND D. E. BEVAN". U. S. Dept. of Comm., NOAA Fish. Bull., 71(3): 661-663.

17287. Iwanago, P. M., and J. D. Hall (Dept. of Fish. and Wildl., Oregon State Univ., Corvallis, Oregon). 1973. EFFECTS OF LOGGING ON GROWTH OF JUVENILE COHO SALMON. Environmental Protection Agency, Ecological Res. Series Report EPA-R3-73-006, 35 p., available from GPO Sup. Doc. as EP1.23: 73-006, $0.75; Selected Water Resources Abstracts, 6(18): p. 72.

The objective was to study the effects of increased water temperature characteristic of clearcut watersheds of Pacific coastal streams upon the growth rate of juvenile coho salmon. The natural temperature fluctuations of the stream were used in the study of growth of underyearling fish held in aquariums and fed at various consumption levels. Juvenile coho fed in the control stream grew somewhat faster than did those that experienced the warmer temperatures of the clearcut stream. This was particularly true at low levels of consumption. Growth rates of juvenile coho salmon in the wild state were found to be slightly higher in the clearcut stream as compared to the unlogged stream. This difference from the experimental results may have been due to a change in availability and abundance of food. There was a marked decrease in the cutthroat trout population in the clearcut stream, which may have reduced competition for food. There was no apparent influence of infestation by salmon poisoning fluke on the condition of the juvenile coho in the clearcut stream.

17288. Davidoff, E. B., R. W. Rybicki, and K. H. Doan (Res. Branch, Manitoba Dept. of Mines, Resources, and Environmental Mgmt, Winnipeg, Manitoba R3C 0P8, Canada). 1973. CHANGES IN THE POPULATION OF LAKE WHITEFISH (Coregonus clupeaformis) IN LAKE WINNIPEG FROM 1944 TO 1969. J. Fish. Res. Bd. Canada, 30(11): 1667-1682.

Whitefish catches have fluctuated since 1952, and except in 1964 each successive peak has decreased in magnitude. Recently the overall trend has been a diminishing fishery with increasing effort. There has been a drastic change in age composition with time. Age-groups 5, 6, and 7 accounted for 81% of the catch from 1944 to 1948, age-groups 4, 5, and 6 for 89% from 1949 to 1955, age-groups 4 and 5 for 86% from 1959 to 1968, and age-groups 3 and 4 for 88% in 1969. The fishery is now dependent upon two age-groups instead of three. Natural failure of one or more important year-classes would result in a serious decline in catch, and partial or complete collapse of this fishery. Annual survival rate decreased from 34%, 1944-48 to 12%, 1959-69. Instantaneous natural mortality rate was estimated to be 0.72, and may be overestimated. The 1938-39, 1945-47, 1949, and 1957 year-classes were strong, while the 1940-44, and 1956, 1958, and 1961 year-classes were weak. The 1959 and 1960 year-classes appeared to be somewhat above average. Examination of data on total dissolved solids and temperature indicated that ecological changes were not responsible for the decline of whitefish in Lake Winnipeg. We judge that the optimum rate of fishing has been exceeded, and that the fishery itself is largely responsible for the depleted condition of the whitefish stocks in Lake Winnipeg. Fishing effort must be reduced to the point where the fishery is again dependent upon three year-classes. This should result in higher catches, and provide less fluctuation in annual catches. (Authors)

17289. Hirose, Keiji, Tesuya Hirano, and Rikizo Ishida (Ocean Res. Inst., Univ. of Tokyo, Japan). 1974. EFFECTS OF SALMON GONADOTROPIN ON OVULATION IN THE AYU, Plecoglossus altivelis, WITH SPECIAL REFERENCE TO WATER BALANCE. Contribution from Tokai Regional Fish. Res. Lab., B-573; Comp. Biochem. Physiol., 47(1A): 283-289.

Ovulation was induced in mature female ayu, Plecoglossus altivelis, 3 days after injection of partially purified salmon gonadotropin. The gonadotropin-treated fish ingested a significantly greater quantity of water than the control fish: the body weight increased by 3 percent in the hormone-treated fish, whereas it decreased by 3 percent in the saline-injected control due to starvation. Ovarian weight and water content of the ovary were significantly greater in the hormone-treated fish than in the control fish, although there was no change in the plasma ion concentrations and in the muscle water content. Water ingestion and hydration of oocytes induced by gonadotropin may be important factors in inducing ovulation in the ayu. (Authors)

17290. Baeyens, D. A., J. Russell Hoffert, and P. O. Fromm (Dept. of Physiol., Mich. State Univ., East Lansing, Michigan 48823). 1974. A COMPARATIVE STUDY OF THE INFLUENCE OF OXYGEN ON LACTATE DEHYDROGENASE. Comp. Biochem. Physiol., 47(1B): 1-7.

Homogenates of retina, liver and brain tissue from trout, frogs and dogs were exposed to hyperbaric tensions of oxygen and nitrogen for 24 hr and then assayed for lactate dehydrogenase (LDH) activity. With the exception of trout retina all tissue preparations exhibited a lower LDH activity when exposed to hyperbaric oxygen. In general, the electrophoretic mobilities of the various LDH isozymes were not altered by exposure to high oxygen thus the decrease in enzyme activity could not be associated with changes in tertiary structure or intermolecular disulfide bridge formation. It is hypothesized that the observed decreased LDH activity is caused by oxygen affecting the active and/or allosteric site on the enzyme. Apparently there is some protective mechanism which prevents inactivation of teleost retinal LDH upon exposure to hyperbaric oxygen tensions. Mammalian hepatic, retinal and brain tissue demonstrated altered LDH kinetics after oxygen treatment. Increased K_m values signified a decreased affinity of the enzyme for substrate resulting in a decreased rate of product formation after oxygen exposure. Analyses of data for LDH activity in the teleost retina according to the "Michaelis-Menten constant" indicated that the enhanced enzyme activity in the oxygen exposed tissue was related to an increase in the affinity of the enzyme for substrate (i.e. decrease in K_m value). (Authors)

17291. Schindler, D. W., V. E. Frost, and R. V. Schmidt (Fish. Res. Bd. of Canada, Freshwater Inst., Winnipeg, Manitoba R3T 2N6, Canada). 1973. PRODUCTION OF EPILITHIPHYTON IN TWO LAKES OF THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO. J. Fish. Res. Bd. Canada, 30(10): 1511-1524.

Two new techniques for measuring photosynthesis by benthic algal flora in waters low in dissolved inorganic carbon are described. The first uses gas chromatography to measure changes in DIC in incubation chambers directly. The second is a variation of the usual ^{14}C procedure, in which disappearance of ^{14}C from the water is measured by liquid scintillation instead of uptake of ^{14}C by the algae. This procedure is simpler than measuring the uptake of ^{14}C, because digestion and/or combustion of samples is not necessary. Results are compared with the commonly employed ^{14}C uptake and O_2 release techniques. Tests showed that heterogeneity of substrate was the major source of variation in in situ results, being large enough to make interpretation of seasonal effects and other causal factors extremely difficult. Annual production by epilithiphyton in two natural lakes in the Experimental Lakes Area (ELA) was 5.19 g C and 5.18 g C/m^2 of substrate annually for lakes 239 and 240, respectively. These are the lowest values recorded for freshwater lakes at temperate latitudes. Because DIC and O_2 concentrations could be measured simultaneously, it was possible to calculate photosynthetic quotients on several dates. These were extremely high, averaging 2.6 for the summer of 1971. (Authors)

17292. Trzebiatowski, Rajmund (Akademia Rolnicza w Szczecinie, Inst. Ichtiologii, Poland). 1973. TOXIC EFFECT OF DETERGENTS TYPE DBS AND TBS UPON FISHES. (Toxsyczne dzialanie na ryby detergentow typu DBS i TBS). Roczniki Nauk Rolniczych, 95(2): 83-94. In Polish with English synopsis.

Results of toxicity tests of detergents solutions (1-50 mg SA/1) of Deterlone (SA-sodium dodecynolbenzenesulphonate) and of Marlone (SA-sodium tetrapropylenebenzenesulphonate) for common carp and rainbow trout fry. The carp fry proved to be more resistant to the toxic effect of the detergents. The toxicity of Deterlone was found to be higher than that of Marlone. Deterlone concentration gradient of 1 mg SA/1, and that of Marlone of 3 mg SA/1 were accepted to be non-toxic for the fishes tested. (Auth.'s synopsis)

17293. Holden, A. V., and R. Lloyd (Freshwater Fish. Lab., Faskally, Pitlochry, Perthshire, United Kingdom). 1972. SYMPOSIUM ON THE NATURE AND EXTENT OF WATER POLLUTION PROBLEMS AFFECTING INLAND FISHERIES IN EUROPE. SYNTHESIS OF NATIONAL REPORTS. EIFAC Technical Paper No. 16, 20 p.

17294. Amlacher, E. 1972. HANDBOOK OF FISH DISEASES FOR VETERINARIANS AND BIOLOGISTS. Veb Gustav Fischer Verlag, Jena, East Germany, 2nd Edition, 378 p., illus.; Selected Water Resources Abstracts, 6(20): p. 68.

Important data are presented on diseases of inland fish, including etiology, pathogenesis, epidemiology, pathological histology, histochemistry, therapy and prophylaxis. These diseases include viruses, bacterioses, mycoses, protozoonoses, helminthoses and those caused by dinoflagellates and parasitic crabs. Environmental factors are also covered. Examination techniques for each disease group and methods for shipping are discussed. A diagnostic chart lists symptoms, diseases and control measures. A subject index and bibliography are included. -- Biological Abstracts, Inc.

17295. Dangel, James R., Paul T. Macy, and Fred C. Withler (Coll. of Fish., Univ. of Washington, Seattle, Wash. 98195). 1973. ANNOTATED BIBLIOGRAPHY OF INTERSPECIFIC HYBRIDIZATION OF FISHES OF THE SUBFAMILY SALMONINAE. U.S. Dept. of Comm., NOAA Technical Memorandum NMFS NWFC-1, 48 p.

This bibliography of 611 annotated references lists published and unpublished material on hybridization between species of the subfamily Salmoninae and crosses of salmonids with non-salmonids. It does not include crosses within a species. The bibliography is indexed by species for the genera Brachymystax, Hucho, Oncorhynchus, Salmo, Salmothymus, and Salvelinus and certain non-salmonid species. (Authors)

17296. Giardina, B., E. Antonini, and M. Brunori (Lab. of Molec. Biol., Univ. of Camerino, Italy). 1973. HEMOGLOBIN IN FISHES: STRUCTURAL AND FUNCTIONAL PROPERTIES OF TROUT HEMOGLOBINS. Netherlands Journal of Sea Research, Vol. 7, pp. 339-344.

Homogeneous components of trout hemoglobin (Salmo irideus), have been investigated from the structural and functional point of view. Only one (Hb trout IV) of the 2 major components found in trout hemoglobin is characterized by a Root effect; the other components (Hb trout I and II) are not affected by pH at all. No change was observed in the CD spectrum going from ligand bound to ligand free Hb trout I; instead ligand binding by Hb trout IV has an effect on the CD which is very similar to that observed for human hemoglobin. Kinetic experiments on the O_2 and CO reactions show a similarity in behaviour of trout hemoglobin components at pH 7.5. Hb trout I, as well as Hb trout II, is pH independent, while the kinetic behaviour of Hb trout IV is strongly pH dependent. Where the Root effect is operative, the dissociation velocity of oxygen increases largely, thus suggesting that the kinetic basis of the Root effect resides, at least in part, in the off constants. (Authors' summ.)

17297. Noble, Richard L. (Dept. of Natural Resources, Cornell Univ., Ithaca, New York 14850). 1973. EVACUATION RATES OF YOUNG YELLOW PERCH, Perca flavescens (Mitchill). Trans. Amer. Fish. Soc., 102(4): 759-763.

Gastric evacuation of a single meal of zooplankters by young yellow perch was about half as fast as that of a similar meal under conditions of continuous feeding. Time for gastric evacuation of a single meal of 150 to 200 daphnids by 60-mm perch at 15 C was 12 hours compared to only 6 hours for a similar meal under conditions of continuous feeding. Likewise, 30- to 40-mm perch fed 10 daphnids at 22 C required 6.5 and 1.5 hours respectively for single and multiple meals. Longer evacuation times were required for larger initial meals when subsequent meals were fed to 30- to 40-mm fish at 22 C. Median evacuation time for the first daphnid consumed was only 0.6 hour compared to 2.6 hours for the one-hundredth daphnid. Evacuation time for continuously feeding fish increased with size of fish. Gastric evacuation time at 20 to 22 C increased from 0.6 hours for fish 17 to 19.5 mm long to over 3 hours for 45-mm fish. Because of the effect of meal sequence on evacuation time, conventional methods of estimating digestion rate may be inadequate for fish which feed continuously. (Auth.)

17298. Wells, Barbara, D. H. Steele, and A. V. Tyler (Marine Sciences Res. Lab., Memorial Univ. of Newfoundland, St. John's, Nfld., Canada). 1973. INTERTIDAL FEEDING OF WINTER FLOUNDERS (Pseudopleuronectes americanus) IN THE BAY OF FUNDY. J. Fish. Res. Bd. Canada, 30(9): 1374-1378.

Flounders captured in summer in the intertidal zone at high tide fed mainly on food species that live in that zone. Flounders captured in the subtidal zone fed partially on food species that live there, and partially on intertidal food species. From these feeding habits, and from the magnitude of the movement into the intertidal zone (previously reported), we conclude that large intertidal areas are major feeding grounds for winter flounder. The quantities of filamentous algae in the stomachs suggest that winter flounders can utilize plant material. (Authors)

17299. Kolesnik, Yu. A. (Pacific Res. Inst. for Sea Fisheries and Oceanography, (TINRO), Vladivostock, USSR). 1972. SOME QUESTIONS RELATING TO GROWTH AND METABOLIC RATE IN ANIMALS. J. Ichthyol., 12(5): 860-863.

A mathematical analysis is given of the growth writings of Bertalanffy, Taylor and Vinberg.

17300. Wunsch, Carl (Mass. Inst. of Technology, Cambridge, Massachusetts). 1973. ON THE MEAN DRIFT IN LARGE LAKES. Limnology and Oceanography, 18(5): 793-795.

Large northern hemisphere lakes show an apparent mean surface drift in the counterclockwise direction. The effect can be explained by the Lagrange drift induced at second order by internal Kelvin waves. Reversals of the mean drift with depth are predicted. (Auth.)

17301. Tramer, Elliot J., and Philip M. Rogers (Dept. of Biol., Univ. of Toledo, Toledo, Ohio). 1973. DIVERSITY AND LONGITUDINAL ZONATION IN FISH POPULATIONS OF TWO STREAMS ENTERING A METROPOLITAN AREA. Amer. Midl. Nat., 90(2): 366-374.

The distribution and relative abundance of fishes were surveyed in Swan and Tenmile creeks, Lucas Co., Ohio, from their headwaters in a rural agricultural area to points near the center of the city of Toledo, Ohio. Twenty-one species were found in each creek. Of the total of 27 species collected only two, Semotilus atromaculatus and Notropis stramineus occurred at each sample station. Species diversity along both streams followed no definite pattern, even when the creeks became grossly polluted, since declines in the number of species present were often upset by shifts toward relative abundances which were more evenly distributed. Fish species diversity was not correlated with an index of habitat diversity. Furthermore, unlike other longitudinal zonations, diversity was not correlated with mean depth of the stream or with distance from the headwaters, and species composition changes took the form of replacements rather than additions to the headwaters assemblage. We conclude that pollution stress cancelled out the effects of factors such as substrate diversity and mean depth, thereby obliterating the normal patterns of diversity and longitudinal zonation. (Authors)

17302. Sneed, K. E. (Warmwater Fish Cultural Lab., P.O. Box 860, Stuttgart, Arkansas 72160). 1971. THE WHITE AMUR: A CONTROVERSIAL BIOLOGICAL CONTROL. The American Fish Farmer & World Aquaculture News, 2(6): 6-9; Weed Abstracts, 22(8): p. 180, 1973.

Research on the use of white amur (Ctenopharyngodon idella) for the control of aquatic vegetation is reviewed. The fish should be introduced in sufficient numbers to control but not eliminate vegetation. The optimum stocking rate of 1- to 2-lb fish for control of Najas and Potamogeton spp. in the USA is between 40 and 50/acre. The pros and cons of the widespread introduction of fish as agents for vegetation control are discussed. On the basis of trials in the USA, it is predicted that the white amur will some day be fully accepted as an aquatic weed control agent.

17303. Higley, Duane L., and Carl E. Bond (Dept. of Fish. & Wildl., Oregon State Univ., Corvallis, Oregon 97331). 1973. ECOLOGY AND PRODUCTION OF JUVENILE SPRING CHINOOK SALMON, Oncorhynchus tshawytscha, IN A EUTROPHIC RESERVOIR. U.S. Dept. of Comm., NOAA Fish. Bull., 71(3): 877-891.

Juvenile spring chinook salmon, Oncorhynchus tshawytscha, were reared in a central Oregon reservoir of 7.5 hectare. The reservoir is strongly eutrophic, as shown by its heavy sedimentation, summer stratification, and chemical qualities (total dissolved solids over 200 ppm, total phosphorus to 0.4 ppm, and summer pH between 9 and 10). Surface water temperatures ranged from 3° to 29°C. Salmon were apparently confined to the upper 3 m during the summer because of low dissolved oxygen below this depth. In 1961, epilimnion conditions of high pH, high temperatures, decreasing oxygen concentrations, and possibly algal toxins caused condition loss and deaths among salmon. Fry planted in 1961 (75,300) and in 1962 (150,000) suffered first-summer mortalities in excess of 80%, primarily due to predation by older salmon. Summer growth was rapid, but dependent on population densities. Coho salmon, O. kisutch, and chinook salmon remaining from a 1959 plant averaged 280 and 215 g after 30 mo. The 1961 year class averaged 62 g at 10 mo and 89 g at 22 mo. The 1962 year class averaged 22 g at 9 mo. Average condition factor values rose above 1.20 in the summer. Net production by the 1961 year class was 159 kg/hectare in 1961 and 35.5 kg/hectare in 1962. The 1962 year class produced 170 kg/hectare in 1962. Potential December yield of first-year salmon was 98 kg/hectare in 1961 and 73.5 kg/hectare in 1962. First-year salmon ate primarily Entomostraca and chaoborid larvae. Apparently competition from the 1962 year class caused the 1961 year class to feed more on littoral and terrestrial forms and to grow and produce less in their second year. Age class I and age class II salmon weighing from 25 to 189 g emigrated via spillway outflows. In 1963, migrations occurred only at temperatures above 10°C; this relationship was not observed in 1962. This reservoir, or others with similar limnological conditions, cannot be recommended as a rearing site for chinook salmon because of the severe summer conditions. (Authors)

17304. Bidgood, B. F. (Fish & Wildl. Div., Alberta Dept. of Lands and Forests, Edmonton, Alberta, Canada). 1973. DIVERGENT GROWTH IN TWO LAKE WHITEFISH (Coregonus clupeaformis) POPULATIONS. J. Fish. Res. Bd. Canada, 30(11): 1683-1696.

Divergence in the growth pattern of Pigeon Lake and Buck Lake whitefish (Coregonus clupeaformis) began during the winter months in young-of-the-year fish. The growth rate of individuals in the Pigeon Lake whitefish population has declined over the past 12 years whereas individuals in the Buck Lake population have maintained a relatively stable growth pattern. These differences did not appear to be genetically controlled. Increased interspecific and intraspecific competition for the available food supply likely suppressed the growth rate of the Pigeon Lake whitefish population. Reduction of predator numbers in Pigeon Lake by the removal of habitat and increased angling pressure accelerated recruitment to both the whitefish population and other competitive feeding forage fish. A predator-prey relationship conducive to the maintenance of a faster growing lake whitefish population has been maintained in Buck Lake over the same period of time. (Auth.)

17305. Bootsma, R. (Dept. of Special Animal Pathol., Fac. of Vet. Medicine, Biltstraat 172, Univ. of Utrecht, The Netherlands). 1973. INFECTIONS WITH Saprolegnia IN PIKE CULTURE (Esox lucius L.). Aquaculture 2, pp. 385-394.

In Dutch pike hatcheries egg fungus and fungal diseases of fry are exclusively caused by Saprolegnia species. Histopathological examination of diseased fry revealed that Saprolegnia may invade vital organs such as the liver. Of the staining techniques that were applied to detect Saprolegnia in tissue, only Grocott's method gave satisfactory results. In comparing the in vitro fungistatic properties of chloramine T, formalin and malachite green oxalate with the toxicity of these chemicals to young pike, malachite green oxalate appeared to give the best results. The use of fungistatics in pike culture should be prophylactic rather than therapeutic. (Auth.)

17306. Born, Stephen M., Thomas L. Wirth, Edmund M. Brick, and James O. Peterson. 1973. RESTORING THE RECREATIONAL POTENTIAL OF SMALL IMPOUNDMENTS. THE MARION MILLPOND EXPERIENCE. Dept. of Natural Resources, Madison, Wisconsin Technical Bulletin No. 71, 20 p., illus.

There are many small water bodies in the upper midwest that are located in or near municipalities. These waters are, or potentially are, important local recreational resources. Silting, heavy growths of algae and rooted aquatic vegetation and declining fisheries have severely limited the recreational potential of many of these small lakes and flowages. This publication describes some of the methods of rehabilitating and managing these water resources. Marion Millpond, a 110-acre impoundment in east central Wisconsin, was selected as the site for demonstrating lake improvement techniques. Demonstration work was divided into in-pond, shoreland and drainage basin activities. In-pond activities included dam modification, stump and log removal, sediment manipulation, application of various bottom treatments (plastic sheeting, sand blankets, etc.) and fish restocking. The shoreland program included grading and rip-rapping selected shoreland areas for erosion control, recontouring and revegetation of dredged "spoils" and enhancing recreational facilities (beaches, boat launching facilities, park areas) around the pond. Drainage basin efforts were limited to a demonstration of simple remedial measures for reducing nutrient and sediment runoff at three farms in the largely agricultural watershed. The Marion Millpond restoration was completed in August, 1971, reestablishing the recreational value of the flowage. The project successfully developed efficient techniques for stump and log removal, and for the application of various bottom treatments to suppress rooted plant growth. After two years of monitoring, treated areas generally exhibited less plant growth than untreated areas; the application of plastic sheeting with a sand or gravel covering was most effective. The reduction in rooted aquatic plant problems was accompanied by the invasion of the algae, Chara, which will continue to pose some aquatic plant problems in the millpond. Because the impoundment was overfertile, the rehabilitation did not substantially decrease nutrient loading, continued aquatic plant problems are anticipated. Fairly intensive management procedures will be necessary to maintain the pond's recreational usability. The major impetus for planning and implementation of this project came from local residents. The project has clearly shown how local interests, given the requisite technical advice and partial financial support, can undertake substantial environmental improvement programs. Without the strong local commitment, this renewal project could not have been accomplished. (Authors)

17307. Houston, A. H., C. L. Czerwinski, and R. J. Woods (Dept. of Biology, Marquette Univ., Milwaukee, Wisconsin). 1973. CARDIOVASCULAR-RESPIRATORY ACTIVITY DURING RECOVERY FROM ANESTHESIA AND SURGERY IN BROOK TROUT (Salvelinus fontinalis) AND CARP (Cyprinus carpio). J. Fish. Res. Bd. Canada, 30(11): 1705-1712.

Brook trout (Salvelinus fontinalis) and carp (Cyprinus carpio) were subjected to handling, anesthesia, and extensive experimental pretreatment, including the emplacement of electrocardiograph electrodes and of buccal, cleithral, dorsal aortic, and urinary bladder catheters. Determination of oxygen consumption, cardiac and ventilatory rates, and rate ratios, ventilatory flow, ventilatory stroke volume, and gross oxygen utilization were subsequently carried out at intervals over a 26-hr post preparation period. Four general patterns of functional variation were observed during recovery. In the most common pattern, activity changed steadily to a final value. Other patterns were characterized by an initial lag phase of intermediate maximum, minimum, or plateau values prior to apparent stabilization. Brook trout required longer than carp for recovery, and differed from carp in the relationship between ventilation and oxygen utilization during recovery. Provision for recovery periods of not less than 24 hr is recommended for studies involving preexperimental preparations of the type studied. (Authors)

17308. FAO of the United Nations (Research Information Section, Fishery Resources Div., Rome, Italy). 1973. DIRECTORY OF EXPERTS ON MARINE POLLUTION. FAO Fisheries Technical Paper No. 99, Revision 1, 91 p.

17309. Pontius, Richard W., and Michael Parker (Dept. of Zool. and Physiol., Univ. of Wyoming, Laramie, Wyoming 82070). 1973. FOOD HABITS OF THE MOUNTAIN WHITEFISH, Prosopium williamsoni (Girard). Trans. Amer. Fish. Soc., 102(4): 764-773.

Quantitative and qualitative analyses of organisms eaten by mountain whitefish in the Snake River were undertaken. Abundance of an organism in a whitefish stomach appears to be dependent upon the organism's overall availability. The stomach contents of all size classes differed in taxonomic composition. Overlap in the taxonomic categories of food organisms eaten by fish of size classes II and III was about 50%. Larger fish were more generalized feeders and could utilize a greater size range of prey organisms than could smaller fish. This was reflected in the increase of food length diversity (FLD) and food taxa diversity (FTD) with increasing fish size. FTD was correlated most closely with the taxonomic richness of stomach contents rather than relative abundance of items in each taxonomic category. Hence, merely counting the taxa in stomachs gave some measure of FTD. This suggests that choices concerning the type of food eaten (species richness component of diversity) are most important in affecting FTD. Comparison of stomach contents with drift and bottom samples showed that fish could not have fed randomly solely from the drift or solely from the bottom. Morphology of the whitefish and the occurrence of sand and gravel in stomachs are an indication of bottom feeding. (Authors)

17310. Lean, D. R. S. (Canada Centre for Inland Waters, Lakes Research Div., Burlington, Ontario, Canada). 1973. MOVEMENTS OF PHOSPHORUS BETWEEN ITS BIOLOGICALLY IMPORTANT FORMS IN LAKE WATER. J. Fish. Res. Bd. Canada, 30(10): 1525-1536.

A model consistent with the kinetics of phosphorus in epilimnetic lake water was developed. Adding $^{32}PO_4$ to lake water and separating the major forms of dissolved phosphorus by Sephadex gel filtration showed that the exchange mechanism between inorganic phosphate and the particulate fraction predominates. At the same time, a low-molecular-weight phosphorus compound is excreted which combines with colloids in lake water, releasing phosphate from the colloid and making the phosphate available for "transfer" again. This rapid cycling of phosphorus between the four principal forms - the particulate fraction, the low-molecular-weight P compound, colloidal P, and phosphate - appears to contribute to formation of colloids in lake water. No direct complexing of phosphate to the colloid was observed. Only in the presence of algae, bacteria, and other particulate matter did the radioactive phosphorus move to the low-molecular weight and the colloidal forms. The low-molecular-weight compound is negatively charged, as is the colloidal P, but to a lesser degree. Both are removed by anion exchange materials along with phosphate, but the rate that they move into the fraction removed by membrane filtration is different from that for phosphate. When filtrate is refiltered a large amount of the colloidal P is retained by the filter. This complicates measurements of transfer and makes previous studies on utilization of dissolved organic phosphorus of doubtful value since corrections for filter retention were rarely, if ever, made. (Auth.)

17311. Ogawa, R. 1973. CAUSES FOR CHANGES IN PHYTOPLANKTON DOMINANCE. Great Lakes Fishery Lab., Ann Arbor, Michigan, 236-237; Weed Abstracts, 22(5): abstract 929.

Research on algae by the Great Lakes Fishery Laboratory is investigating the frequent changes in dominance among diatoms, green algae and blue-green algae. Only blue-green algae with heterocysts (which are capable of fixing N) are able to grow in a nitrate-free medium. All 3 groups of algae normally photosynthesize in red light, but diatoms and blue-green algae also have pigments capable of absorbing green and orange light; in Lakes Superior and Huron where green light penetrates deepest, blue-green algae are dominant. The dominance of the diatom Nitzschia dissipata increases with silica concn.

17312. Sage, Martin (Univ. of Texas Marine Sci. Inst., Port Aransas, Texas 78373). 1973. THE RELATIONSHIP BETWEEN THE PITUITARY CONTENT OF PROLACTIN AND BLOOD SODIUM LEVELS IN MULLET (Mugil cephalus) TRANSFERRED FROM SEA WATER TO FRESH WATER. Contributions in Marine Science, Vol. 17, pp. 163-167.

Blood sodium levels in Mugil adapting to a transfer from sea water to fresh water stabilized within 24 hours. There was no change in the mean prolactin concentration of the pituitaries at any time from 30 min to 6 weeks following transfer of fish from sea water to fresh water. There were, however, significant changes in the correlation of pituitary prolactin content with blood sodium and body weight. Seawater fish have a pituitary prolactin content which shows no correlation with either body weight or blood sodium, whereas, in fish adapting to fresh water there is a negative correlation between prolactin and blood sodium as well as with body weight. In fish adapted to fresh water for one day or more there was a negative correlation of prolactin with blood sodium but no relationship to body weight. It is thus concluded that prolactin is involved both in the initial stages and the long term adaptation of Mugil to fresh water. (Auth.)

17313. Sawyer, L. D. (Food and Drug Admn., Minneapolis, Minnesota). 1973. COLLABORATIVE STUDY OF THE RECOVERY AND GAS CHROMATOGRAPHIC QUANTITATION OF POLYCHLORINATED BIPHENYLS IN CHICKEN FAT AND POLYCHLORINATED BIPHENYL-DDT COMBINATIONS IN FISH. Journal of the Association of Official Analytical Chemists, 56(4): 1015-1023; Selected Water Resources Abstracts, 6(23): p. 42.

Nine laboratories collaborated on the analyses of PCBs in chicken fat and DDT-PCB combinations in fish. Existing AOAC multipesticide methodology with GLC quantitation was employed. One solution containing a mixture of Aroclors 1254 and 1260 was analyzed by GLC only. The fish samples were subjected to a published silicic acid procedure for separating the DDT-PCB mixtures. The DDT analogs were quantitated before and after the separation. The PCB content was quantitated by total peak height and total area comparisons against appropriate Aroclor (s), using electron capture GLC, and additionally in 6 laboratories by total area comparisons, using halogen-specific detection. The electron capture GLC data demonstrated better accuracy and precision. The following PCB recoveries were obtained by using total peak height comparisons: 5 ppm mixed Aroclor solution, 100 plus or minus 4 percent; 8 ppm Aroclor 1242-fortified chicken fat, 101 plus 13 percent; 7.5 ppm Aroclor 1248-fortified chicken fat, 96 plus or minus 9 percent; incurred Aroclor 1242 chicken fat, 9.2 ppm plus or minus 8 percent; 6 ppm Aroclor 1254-fortified fish, 75 plus or minus 14 percent; 6 ppm Aroclor 1260-fortified fish, 75 plus or minus 15 percent; and an environmentally incurred residue in fish, 4.5 ppm plus or minus 20 percent. The 2 Aroclor-fortified fish samples were concurrently spiked with the p, p'-isomers of DDE, TDE, and DDT at levels of 4, 1, and 3 ppm respectively. After silicic acid separation the combined recoveries for these 2 samples were: DDE, 86 plus or minus 13 percent; TDE, 89 plus or minus 20 percent; and DDT 84 plus or minus 17 percent. Environmentally incurred-DDT residues were recovered at 4.1 ppm plus or minus 14 percent for p, p'DDE, 0.7 ppm plus or minus 24 percent for o, p'-DDT and 2.7 ppm plus or minus 17 percent for p, p'-DDT. The DDT values calculated before the silicic acid separation compared favorably with those summarized. The multiresidue method for chlorinated pesticides, 29.001-29.027, has been adopted official first action to include polychlorinated biphenyls in poultry fat and fish.

17314. Jones, Roger, and C. J. S. Stuart (Dept. of Biol., Trent University, Peterborough, Ontario, Canada). 1973. A SAMPLER FOR THE CHEMICAL ANALYSIS OF FRESHWATERS USING EVACUATED TUBES. Limnology and Oceanography, 18(5): 805-809.

A freshwater sampler is described having three evacuated glass tubes which fill simultaneously at the selected depth when each rubber sealing stopper is pierced by a hypodermic needle. Each tube acts as the sample collector and container. (Authors)

17315. Barber, Willard E., and Niles R. Kevern (Dept. of Fish. and Wildl., Michigan State Univ., East Lansing, Mich.). 1973. ECOLOGICAL FACTORS INFLUENCING MACROINVERTEBRATE STANDING CROP DISTRIBUTION. Hydrobiologia, 43(1-2): 53-75.

Influence of substrate, macrophyte growth and detritus on macroinvertebrate standing crop (numbers and biomass) as well as seasonal variations in standing crop were investigated in a trout stream. Ephemeropterans showed no consistent relationship to substrate type, either in numbers or biomass. Numbers of dipteran larvae (primarily chironomids and simuliids) did not show a definite relationship to substrate size. But a larger biomass was associated with larger substrates. Higher numbers and biomass of trichopterans (including Helicopsyche borealis) were associated with larger substrates. Numbers of coleopteran larvae showed no relation to substrate size, but biomass was greater in large substrates. Biomass and numbers of water mites were generally associated with larger substrates, whereas no relationship was observed in plecopterans. Larger numbers and biomass of ephemeropterans, dipterans (chironomids and simuliids but no other dipterans) and trichopterans are associated with macrophyte beds; this is attributed to drifting species and those that have summer generations. Macrophyte growth reduced numbers and biomass of H. borealis, but no differences were observed in coleopterans or plecopterans. A substrate/detritus substitution study was done under natural stream conditions. An area of relatively constant current and depth was selected from which eighteen sites were randomly selected. Gravel and detritus were removed and replaced with two distinct sizes of substrate and three different levels of detritus. This was a 2 X 3 factorial analysis design. Ephemeropteran numbers were significantly related to substrate type and detritus level, whereas biomass was only related significantly to substrate. Numbers of chironomids and other dipterans responded significantly to substrate manipulation. Biomass of dipterans other than chironomids was significantly related to substrate type but not detritus level and chironomid biomass did not respond to either manipulations. Trichopteran numbers responded significantly to substrate and detritus manipulations, whereas biomass was significantly related only to substrate type. Analysis of variance showed that coleopteran numbers did not respond significantly to either manipulation; however, orthogonal contrasts showed that, within large substrate, medium detritus level was significantly different from high detritus level. Oligochaetes did not respond to either substrate or detritus manipulation. The responses of the organisms to manipulations are explained in relation to interstitial spaces and oxygen as well as the interaction between substrate type and amount of detritus. (Authors)

17316. Gruchy, C. G., R. H. Bowen, and I. M. Gruchy (Ichthyology Unit, Nat'l. Museum of Nat. Sciences, Ottawa, Ontario, Canada). 1973. FIRST RECORDS OF THE SILVER SHINER, Notropis photogenis, FROM CANADA. J. Fish. Res. Bd. Canada, 30(9): 1379-1382.

A series of specimens of the silver shiner, Notropis photogenis, from the Grand River drainage of Ontario provide the first records for the species from Canada. The specimens are described and some aspects of their ecology are discussed. The species is believed to be indigenous to Canada. (Authors)

17317. Gaygalas, K. S. (Inst. of Zool. and Parasitol., Lithuanian Acad. of Sci., Vilnius, Lithuania). 1972. MORPHOLOGICAL AND ECOLOGICAL CHARACTERISTICS, POPULATION STRUCTURE AND THE STATE OF THE STOCKS OF THE EUROPEAN WHITEFISH [Coregonus lavaretus lavaretus (L.)] IN THE KURSHYU-MARES (KURISCHES HOFF) AND SOME ASPECTS OF FISHERY REGULATION. J. Ichthyol., 12(6): 953-961.

The article contains an account of the results of an investigation of the morphometry, spawning, growth, fecundity and population structure of the European whitefish [Coregonus lavaretus lavaretus (L.)] in the Kurshyu-Mares, and of the state of its stocks and the fishery regime. It is noted that the reduction in whitefish catches is a consequence of the irrational intensification of fishing with active fishing gear in the main spawning grounds. It is proposed that in order to restore the abundance of the stock to the level of previous years real limits should be placed on removals, the catch in spawning grounds should be limited and propagation measures should be organized. (Auth.)

17318. Barans, Charles A., and Richard A. Tubb (Ohio State Coop. Fish. Unit, Ohio State Univ., Columbus, Ohio 43210). 1973. TEMPERATURES SELECTED SEASONALLY BY FOUR FISHES FROM WESTERN LAKE ERIE. J. Fish. Res. Bd. Canada, 30(11): 1697-1703.

When four species of fish were taken from western Lake Erie in each of four seasons and held usually for less than 7 days at ambient lake temperatures, the temperatures they selected during 2-3 days in a horizontal temperature gradient differed seasonally. The differences were largely attributable to the conditions at which the fish had been acclimatized in the lake, and were modified by acclimation during 2-3 days in the gradient. The selected temperatures provided insights into the temperatures that might be selected by these species each season if the lake basin or other waters with similar seasonal ambient temperatures were subjected to thermal discharges. Temperatures selected were above ambient lake temperatures except for emerald shiners (Notropis atherinoides) in summer and fall. In general, white bass (Morone chrysops) and smallmouth bass (Micropterus dolomieui) selected a high range in temperatures throughout the year (18-30 C and 18-31 C, respectively,) yellow perch (Perca flavescens) an intermediate range (10-29 C) and emerald shiners the lowest range (6-23 C). Three of the species were distributed within a relatively precise temperature range in the summer and within a larger range during other seasons; emerald shiners selected a narrow range during all seasons. A fairly stable temperature preference was usually reached within several hours in summer, but the temperatures selected by three species generally increased with time in the gradient during the other seasons; emerald shiners selected constant temperatures in all seasons. Temperatures selected by young and adults differed mainly in yellow perch and emerald shiners in summer and winter, when the lake temperatures fluctuated least. (Authors)

17319. Wilkins, N. P., and F. L. Clarke (Dept. of Zool., University College, Galway, Ireland). 1974. THE SIZE AND SHAPE OF ERYTHROCYTES IN THE HERRING Clupea harengus L. Comp. Biochem. Physiol., 47(1A): 341-345.

The size and two-dimensional shape of mature erythrocytes were measured in twenty-eight herring of varying size from 13 to 31.5 cm. The modal cell size was 10 X 6.7μ. Mature erythrocytes tended to be more elliptical in outline in smaller individuals, becoming more circular in the larger fish. (Authors)

17320. Cooper, J. C., and A. D. Hasler (Lab. of Limnol., Univ. of Wisconsin, Madison, Wisconsin). 1973. II. AN ELECTROPHYSIOLOGICAL APPROACH TO SALMON HOMING. Fish. Res. Bd. of Canada Technical Report No. 415, 44 p. Manuscript status.

The EEG technique is not an entirely reliable method for differentiating between salmon from different home streams. This is because there does not appear to be a unique response to a specific homestream water. The analysis of the EEG is complicated by responses resulting from recent exposure to odors and by responses to non-specific stimulatory products. The EEG responses are not always directly related to behavioral responses. There may be strong EEG responses and no behavioral responses to a given substance. The EEG technique is useful for detecting differences in responses to specific substances, i.e. the presence or absence of morpholine in the past history of salmon. However, it is often necessary to test with concentrations far exceeding behavioral thresholds. The EEG technique has been used to show that salmon can respond to morpholine 18 months from the time of last exposure to this chemical. Therefore, we hypothesize a long-term memory of this odor. The EEG results did correlate well with the results from census experiments and from behavioral experiments with morpholine. There may be, for salmon, a substitution or inhibition of recent cues by the retained information - long-term memory - (learned by imprinting) about the stream odor. There appears to be a build-up in the magnitude of the evoked potential to morpholine towards the peak of the spawning season, indicating an increased importance of long-term memory at this time. (Authors' summ.)

17321. Lovell, Richard T., and Lewis A. Sackey (Dept. of Fish. and Allied Aquacultures, Auburn Univ., Auburn, Alabama 36830). 1973. ABSORPTION BY CHANNEL CATFISH OF EARTHY-MUSTY FLAVOR COMPOUNDS SYNTHESIZED BY CULTURES OF BLUE-GREEN ALGAE. Trans. Amer. Fish. Soc., 102(4): 774-777.

An objectionable "earthy-musty" flavor is frequently found in intensively-cultured catfish which renders the fish unmarketable. Fifty-gram channel catfish were held in 150-liter stainless-steel tanks containing dense masses of either Symploca muscorum or Oscillatoria tenuis to determine the capability of these geosmin-producing blue-green algae to impart this type of off-flavor in the fish. Within 2 days the fish had acquired distinct earthy-musty flavor similar to the odor of the algae. Flavor intensity reached a maximum at 10 days. When fish which had been in the algae tanks for 14 days were transferred to flowing, charcoal-filtered water, the flavor disappeared after 10 days. Fish held in tanks containing algae-free filtrate from the algae culture tanks acquired the off-flavor but at a slower rate than the fish in the culture tanks. This indicated that the fish could absorb the flavor compounds without ingesting the algae, possibly across the gill membranes. (Authors)

17322. Davis, John C., and Barbara J. Mason (Fish. Res. Bd. of Canada, Pacific Environment Inst., West Vancouver, British Columbia, Canada). 1973. BIOASSAY PROCEDURES TO EVALUATE ACUTE TOXICITY OF NEUTRALIZED BLEACHED KRAFT PULP MILL EFFLUENT TO PACIFIC SALMON. J. Fish. Res. Bd. Canada, 30(10): 1565-1573.

A series of bioassays was carried out to assess the acute toxicity of neutralized, filtered, bleached kraft pulp mill effluent (BKME) from a single mill to underyearling Pacific salmon in fresh soft water, at 10-13 C. Toxicity expressed in terms of the 96-hr LC50 varied from 22% of full strength BKME to nontoxic in different collections. A procedure is described for estimating the 4-day LC50 from geometric mean survival time data. Toxicity of effluents changed unpredictably with storage (even at 2 C), and declined with air stripping. Comparison of continuous flow and static test procedures indicated that continuous flow procedures yield somewhat higher toxicity results than static tests. Experiments with varying fish densities indicate that measurable toxicity is less in static tests with heavy fish loading. Use of loading densities of 2.5 liters/g fish or better is recommended. Young sockeye salmon (Oncorhynchus nerka) appeared most sensitive, and pink (O. gorbuscha) and coho (O. kisutch) salmon somewhat more resistant to toxic BKME solutions. No correlation was found between time to death and condition factor in the size range of underyearling coho tested (3.0-7.3 cm). Recommendations are made for routine and regulatory bioassay procedures. (Authors)

17323. Dacre, J. C., and D. Scott (Toxicol. Res. Unit, Med. School, Univ. of Otago, Dunedin, New Zealand). 1973. EFFECTS OF DIELDRIN ON BROWN TROUT IN FIELD AND LABORATORY STUDIES. New Zealand Journal of Marine and Freshwater Research, 7(3): 235-246.

The effects on brown trout, Salmo trutta Linn., and bottom fauna of the Silver Stream, Otago, New Zealand, following an accidental discharge of 55 litres of a dieldrin spray in September 1963 are described. The 24 h LC50 for dieldrin was found to be 0.016 ppm. Residue levels of dieldrin in skeletal muscles, liver, and brain were measured, using a gas-liquid chromatograph, and minimum lethal levels of dieldrin found in these tissues were 1.0-2.0 ppm. (Authors)

17324. Bams, Robert A. (Fish. Res. Bd. of Canada, Pacific Biol. Sta., Nanaimo, British Columbia, Canada). 1973. EVALUATION OF GRAVEL INCUBATORS ON FIRST "HATCHERY" GENERATION TSOLUM RIVER PINK SALMON 1970-72. PART II: EVALUATION AT THE ADULT STAGE. Fish. Res. Bd. of Canada Technical Report No. 405, 17 p. Manuscript status.

Considered in respect of its contribution toward salmon enhancement, the 1970-72 operations of the Tsolum pink salmon stock demonstrated that the hatchery method again achieved its primary goal of significantly increasing the survival rate from egg to returning adult stage without inducing demonstrable adverse effects. (Auth. conclusion).

17325. Bibor, V., and C. Leray (Dept. of Biol., Univ. of Montreal, Montreal, Quebec, Canada). 1973. METABOLISM OF IODINE AND THYROXINE IN Perca flavescens. J. Fish. Res. Bd. Canada, 30(9): 1395-1398.

Two radioisotopes ($Na^{125}I$ and thyroxine ^{125}I) were used to investigate thyroid function in Perca flavescens. In the thyroid, if the hormonal fraction is very small (4% of total radioactive thyroid components, 5 days after injection of $Na^{125}I$) the variation of this fraction with time suggests the existence of a rapid turnover of hormones (maximum level before 24 hr). The rapid incorporation of iodine into iodotyrosine compounds by the thyroid (60% of MIT + DIT after 12 hr) also suggests the involvement of a very important biosynthetic activity. At peripheral levels the rapid metabolism of $T_4{}^{125}I$ ($t\,1/2$ = 6 hr in the blood) confirms this view. In the plasma, the level of labelled hormones goes through two maxima followed (48 hr after injection of $Na^{125}I$) by a steady increase. The second maximum observed is probably due to the release of thyroid hormones into the blood, but the first (6 hr after injection of $Na^{125}I$) cannot be related to any known physiological process in fishes. The half-life of ^{125}I in the plasma is the same as that in the whole body (4 days). (Authors)

17326. Pivazyan, S. A. (Sevan Hydrobiol. Sta., Armenian Acad. of Sci., USSR). 1972. THE FOOD AND FOOD INTERRELATIONSHIPS OF THE LAKE SEVAN TROUT [Salmo ischan (Kessler)] AND THE LUDOGA WHITEFISH [Coregonus lavaretus ludoga (Poliakow)]. J. Ichthyol., 12(6): 987-993.

A study has been made of the food of the trout and the whitefish under conditions of the continuing drawdown of Lake Sevan. Considerable similarity is noted in the food of the trout and the whitefish during the spring and summer feeding period when the fish consume mainly amphipods. As the amphipods are consumed other benthic organisms play an increasing role in the food of the trout, while the significance of zooplankton increases in the food of the whitefish. In the autumn and winter, in connection with the transition of whitefish to feeding almost exclusively on zooplankton, the food relations between them and the trout become less strained. The broadening of the range of food items consumed by the trout and the whitefish is an indication of the deterioration which has occurred in their feeding conditions as a result of changes in food resources and a sharp increase in the abundance of whitefish in connection with the drawdown of the lake. (Auth.)

17327. Wojno, Tadeusz (Akad. Rolniczo-Techiczna w Olsztynie, Instytut Rybactwa Srodladowego, Poland). 1973. TESTING OF FEED MIXTURE PELLETS MADE OF PRESERVED FISH OFFALS FOR RAINBOW TROUT FEEDING. Roczniki Nauk Rolniczych, 95(2): 95-109. In Polish with English synopsis.

Twelve feed mixtures in the form of pellets of various composition were tested. Basic components of the pellets were pirosiloryb (fish hydrolysate) and protevit - offals obtained during fish oil production. The feeding mixtures were fed to rainbow trout in the second year of breeding. The tests allowed for determination of satisfactory feeding mixtures to be produced of cheap and easily available components. (Auth.'s synopsis)

17328. Cimino, Michael C. (Ecol. Section, Biol. Sci. Group, The Univ. of Conn., Storrs, Connecticut 06268). 1973. KARYOTYPES AND ERYTHROCYTE SIZES OF SOME DIPLOID AND TRIPLOID FISHES OF THE GENUS Poeciliopsis. J. Fish. Res. Bd. Canada, 30(11): 1736-1737.

Karyotypes of diploid (2n = 48) and triploid (3n = 72) members of a unisexual-bisexual complex of fish of the viviparous genus Poeciliopsis consist of morphologically uniform acrocentrics, graded in size from large to small, and thus unsuitable for tracing evolutionary pathways within the complex. A comparison of blood samples from diploid and triploid forms showed that the mean diameters of erythrocytes of the triploids are one and one-half times those of diploids. This relationship provides an important tool for easily distinguishing the two types in samples taken from field populations. (Auth.)

17329. Hŏgman, Walter J. (Va. Inst. of Marine Sci., Gloucester Point, Virginia 23062). 1973. THE RELATIVE EFFICIENCY OF NYLON GILL NETS AFTER TRANSITION FROM COTTON NETS IN A MULTISPECIES FISHERY. Trans. Amer. Fish. Soc., 102(4): 778-785.

Commercial fishing statistics for lake whitefish (Coregonus clupeaformis), shallow-water lake herring (Leucichthys artedii), yellow perch (Perca flavescens), and suckers (Catostomus spp.) were analyzed separately by principal gears in the fishery for a 42-year period in northern Green Bay, Lake Michigan. The transition from cotton to nylon gill nets occurred 20 years after records began while the pound net remained unchanged. Abundance indices calculated separately for each gear and catch-per-unit-of-effort (CPE) averages for each gear did not show a general increased efficiency for nylon gill nets. After the transition to nylon, efficiency of nylon gill nets relative to cotton before transition was 3.2 for herring, 1.0 for whitefish, 1.2 for perch, and 0.8 for suckers. Similar values were found when the average of the yearly CPE's were compared. The differences between herring and whitefish catches by nylon gill nets relative to cotton may have been due to the respective pelagic and demersal habits of these fishes. Except for herring, the CPE values of the modern fishery can be compared directly with those of the 1929-1945 fishery. New regulations, changes in species composition, and distribution of fishing have modified the 1970+ fishery and any comparisons with former periods should include these influences. (Auth.)

17330. Larmoyeux, Jack D., Robert G. Piper, and Harry H. Chenoweth (Bur. of Sport Fish. & Wildl., Fish Cultural Development Center, Bozeman, Montana 59715). 1973. EVALUATION OF CIRCULAR TANKS FOR SALMONID PRODUCTION. Prog. Fish-Cult., 35(3): 122-131.

This paper describes methods of installation and management of circular tanks, taking advantage of their potential characteristics of self-cleaning, velocity control, and relatively high fish carrying capacity. These units can be used to advantage in modern hatcheries where intensive water use and design flexibility are highly desirable. The advantages and disadvantages of the circular tanks are set forth in relation to hatchery troughs and raceways. (Authors)

17331. Landolt, Marsha L. (Bur. of Sport Fish. & Wildl., Eastern Fish Disease Lab., Leetown, Kearneysville, West Virginia 25430). 1973. Myxosoma cerebralis: ISOLATION AND CONCENTRATION FROM FISH SKELETAL ELEMENTS - TRYPSIN DIGESTION METHOD. J. Fish. Res. Bd. Canada, 30(11): 1713-1716.

An improved method for detection of Myxosoma cerebralis spores is described. Spores were freed from skeletal tissue by trypsin digestion and ether was used for purification of spore suspension. As compared to mechanical grinding, this procedure resulted in a sixfold increase in observable spores. (Auth.)

17332. Chapman, C. J., and O. Sand (Dept. of Agric. and Fish. for Scotland, Marine Lab., Aberdeen AB9 8DB, Scotland). 1974. FIELD STUDIES OF HEARING IN TWO SPECIES OF FLATFISH Pleuronectes platessa (L.) AND Limanda limanda (L.) (FAMILY PLEURONECTIDAE). Comp. Biochem. Physiol., 47(1A): 371-385.

Field measurements of hearing in Pleuronectes platessa and Limanda limanda show that they are sensitive to sounds in the frequency range from 30 to 250 Hz with greatest sensitivity around 110-160 Hz. Both species were sensitive to particle motion. The thresholds in terms of displacement amplitude were 4×10^{-9} cm at the most sensitive frequencies. Above and below this range there was a sharp decline in sensitivity; the thresholds at 40 and 250 Hz were about 5×10^{-8} cm. The sound pressure thresholds decreased by several decibels in the presence of an air-filled balloon, simulating a swimbladder. The mechanism of hearing is discussed and it is suggested that the otolith organs in the labyrinth are the acoustic receptors. Comparison between hearing data for flatfish and for the cod, Gadus morhua, suggests that differences in performance may be attributed to the accessory role of the swimbladder in the hearing of cod. (Authors)

17333. Olson, Kenneth R., and Paul O. Fromm (Dept. of Physiol., Michigan State Univ., East Lansing, Michigan 48823). 1973. MERCURY UPTAKE AND ION DISTRIBUTION IN GILLS OF RAINBOW TROUT (Salmo gairdneri): TISSUE SCANS WITH AN ELECTRON MICROPROBE. J. Fish. Res. Bd. Canada, 30(10): 1575-1578.

Mercury was found in gills of rainbow trout (Salmo gairdneri) which had been exposed to inorganic mercury but not in those exposed to methyl mercury. No specific site for mercury uptake was identified and it is suggested that inorganic mercury enters the gill across the general lamellar surface. High concentrations were found associated with the gill cartilage. Since little ion diffusion occurs during tissue preparation, localization and/or identification of tissues can be accomplished by scans for various elements: sodium (Na), potassium (K), chlorine (Cl), and sulfur (S). The technique is not suitable for identification of highly volatile compounds such as methyl mercury due to the necessity of subjecting tissues to high vacuum conditions, however, we believe electron probe analyses should be useful in studies of active ion transport systems in gill tissue and in investigations of the effects of heavy metal pollutants on fishes. (Authors)

17334. McKim, J. M., G. M. Cristensen, J. H. Tucker, and M. J. Lewis (Natl. Water Quality Lab., Duluth, Minnesota). 1973. EFFECTS OF POLLUTION ON FRESHWATER FISH. J. Wat. Poll. Contr. Fed., 45(6): 1370-1407.

An extensive literature review is presented which is concerned with the effects of pollutants (metals, pesticides, detergents, industrial wastes) on freshwater fish; chemical and biological methods for identifying and determining the effects of such pollutants; and the effects of the water quality parameters salinity, oxygen, and pH on freshwater fish.

17335. Roberts, Ronald J., A. McQueen, W. M. Shearer, and H. Young (Aquatic Pathobiol. Unit, University of Stirling, Scotland). 1973. THE HISTOPATHOLOGY OF SALMON TAGGING III. SECONDARY INFECTIONS ASSOCIATED WITH TAGGING. J. Fish Biol., 5(5): 621-623.

This report covers several types of disease process that developed in tagged Atlantic salmon.

17336. Senn, Harry G., Jack H. Pattie, and John G. Clayton (Wash. State Dept. of Fisheries, Olympia, Washington 98504). 1973. WASHINGTON POND TRAYS AS A METHOD FOR INCUBATING SALMON EGGS AND FRY. Prog. Fish-Cult., 35(3): 132-137.

A new economical method of incubating salmon eggs and fry has been developed which will handle mass numbers and produce a superior quality emerging fry. A formal hatchery building can be eliminated by hatching eggs on windowfrome-like screen-bottom trays placed in standard rearing ponds. The system has been thoroughly tested at many hatcheries under many conditions by using over 125 million salmon eggs and fry. It has been accepted as the sole method for incubating salmon eggs and fry at a new 32 million egg complex. Besides the biological gains, cost comparison favors this new method by as much as 50 to 1 over present systems. (Authors)

17337. Bilinski, E., and R. E. E. Jonas (Fish. Res. Bd of Canada, Vancouver Lab., Vancouver 8, British Columbia, Canada). 1973. EFFECTS OF CADMIUM AND COPPER ON THE OXIDATION OF LACTATE BY RAINBOW TROUT (Salmo gairdneri) GILLS. J. Fish. Res. Bd. Canada, 30(10): 1553-1558.

The oxidative activity of gill filaments was determined by measuring the liberation of $^{14}CO_2$ from Na-lactate-3-^{14}C. In fish surviving the exposure to 10^{-5} M $CdCl_2$ (1.12 mg Cd/liter) for 24 hr or to 10^{-6} M $CuCl_2$ (0.064 mg Cu/liter) for 48 hr, the oxidation of lactate by gills was inhibited by over 50%. The exposure of trout to lower metal ion concentrations resulted in mortalities, but there was no detectable effect on the oxidative activity in gills. (Authors)

17338. Dorfman, Donald (Monmouth Coll., West Long Branch, New Jersey 07764). 1973. ABERRANT SPECIMEN OF WHITE PERCH (Morone americana). Prog. Fish-Cult., 35(3): p. 175.

17339. MacKinnon, J. C. (Fish. Res. Bd. Canada, Marine Ecol. Lab., Bedford Inst., Dartmouth, Nova Scotia, Canada). 1973. ANALYSIS OF ENERGY FLOW AND PRODUCTION IN AN UNEXPLOITED MARINE FLATFISH POPULATION. J. Fish. Res. Bd. Canada, 30(11): 1717-1728.

The seasonal pattern of production processes in an unexploited resident population of American plaice (Hippoglossoides platessoides) in St. Margaret's Bay, N. S., was analyzed with an energetic model which represents an extension of the analytical approach used in fishery theory. During summer, production is about twice the annual net production of 1.5 kcal/m^2 by fish aged 1 and up. The ecological efficiency is 17%, with larvae and 0+ fish accounting for some 20% of total population ingestion and 34% of net population production. Metabolic expenditures constitute the largest fraction (62%) of population energy intake and about 80% of this amount is consumed during summer. Plaice ingest about half the yearly estimated production (25 kcal/m^2) of benthos in the deeper parts of the Bay. (Auth.)

17340. Wildish, D. J., and N. A. Lister (Biol. Sta., Fish. Res. Bd of Canada, St. Andrews, New Brunswick, Canada). 1973. BIOLOGICAL EFFECTS OF FENITROTHION IN THE DIET OF BROOK TROUT. In: Preprints of Papers presented at 165th National Meeting of American Chemical Society, April 8-13, 1973, Dallas, Texas: Amer. Chem. Soc., Div. of Water, Air and Waste Chemistry, 13(1): 79-84, Paper 76; Selected Water Resources Abstracts, 6(23): p. 59.

Aerial insecticide spraying to control the spruce budworm, a defoliating insect pest which seriously reduces tree growth, was begun in 1952 with DDT, but fenitrothion, 0, 0-dimethyl-0 (3-methyl-4-nitrophenyl) phosphorothionate, has been used since 1968. The possibility that aquatic and terrestrial insects killed by operational spray doses of fenitrothion may cause lethal or sublethal effects directly in salmonids was shown by experiments to be unlikely. The highest level found in poisoned insects is 3,000 times less than the level at which behavioral effects were noted. Reductions in insects following spraying may be of sufficient magnitude and persistence to significantly reduce ration and hence reduce salmonid production.

17341. Dizon, Andrew E., Ross M. Horrall, and Arthur D. Hasler (Southwest Fisheries Center, National Marine Fisheries Service, NOAA, P. O. Box 3830, Honolulu, Hawaii 96812). 1973. OLFACTORY ELECTROENCEPHALOGRAPHIC RESPONSES OF HOMING COHO SALMON, Oncorhynchus kisutch, TO WATER CONDITIONED BY CONSPECIFICS. U. S. Dept. of Comm., NOAA Fishery Bull., 71(3): 893-896.

17342. Wallace, Dale C. (Dept. of Biol., Eastern Michigan Univ., Ypsilanti, Michigan 48197). 1973. REPRODUCTION OF THE SILVERJAW MINNOW, Ericymba buccata Cope. Trans. Amer. Fish. Soc., 102(4): 786-793.

A study of the reproduction of Ericymba buccata Cope in Vigo County, Indiana is based on changes in tuberculation in males, condition of the ovary, size and number of ova, and length frequencies of young-of-the-year. Levels of tuberculation are described and prove to be reliable indices of reproductive maturity. Temporal changes in the degree of tuberculation and condition of the ovary as well as changes in number of ova indicate a spawning period from the end of April to at least the end of July. Early in the spawning season both age group II and III males and females contribute most to the breeding population and the larger specimens spawn earlier. Projection of the growth in initially moderate sized ova and lack of abrupt differences in ova size in spring suggest that individual females in age group II spawn more than once within the spawning season. Most age group III males and females die shortly after spawning. Later in the summer (July) large age group I males and females probably breed. Study of ova size and number as well as ovary condition indicates two major spawnings, one in early May and the other in late June or early July. Monthly length frequency distributions of young also indicate two spawning peaks. Long breeding season, fractional spawning of age group II and the late summer spawn of age group I all are adaptive to streams with a shifting sand bottom. (Auth.)

17343. Ritter, J. A., and H. R. MacCrimmon (Coll. of Biol. Sciences, Univ. of Guelph, Guelph, Ontario, Canada). 1973. INFLUENCE OF ENVIRONMENTAL EXPERIENCE ON RESPONSE OF YEARLING RAINBOW TROUT (Salmo gairdneri) TO A BLACK AND WHITE SUBSTRATE. J. Fish. Res. Bd. Canada, 30(11): 1740-1742.

Yearling rainbow trout (Salmo gairdneri) selected black substrate regardless of size or rearing experience when first introduced into an experimental tank offering a choice of black or white. Differences in the degree of black selection among the various lots of the same strain during the initial 120 min of exposure, under an illumination of 10^{-2} lx, were correlated only with the level of swimming activity. By 24 hr, only pond-reared fish continued to select black while laboratory-reared fish were randomly distributed over black and white. The continuing wariness of only the pond-reared fish reveals the long-term effect of prior experience on juvenile trout behavior. This finding indicates the possible feasibility of environmental conditioning for wariness in the artificial propagation of hatchery-reared fish for live release. (Authors)

17344. Sand, Olav (Inst. of Zoophysiol., Univ. of Oslo, Oslo 3, Norway). 1974. RECORDINGS OF SACCULAR MICROPHONIC POTENTIALS IN THE PERCH. Comp. Biochem. Physiol., 47(1A): 387-390.

Microphonic potentials were recorded from the sacculus in the perch during longitudinal vibration of the fish in air. This gives a good simulation of sound stimulation in water. The effective frequencies for evoking microphonic potentials were in good agreement with the previously reported audiograms for this species, thus indicating that the audible frequency range is limited by the peripheral auditory apparatus. (Auth.)

17345. Moyle, Peter B. (Dept. of Zool., Univ. of Minnesota, Minneapolis, Minn.). 1973. ECOLOGICAL SEGREGATION AMONG THREE SPECIES OF MINNOWS (CYPRINIDAE) IN A MINNESOTA LAKE. Trans. Amer. Fish. Soc., 102(4): 794-805.

The life histories of the mimic shiner (Notropis volucellus), the common shiner (N. cornutus), and the bluntnose minnow (Pimephales notatus), from a small Minnesota Lake, were compared in order to find out how temperate fish species segregate ecologically and how accurate dietary studies are for showing ecological differences among similar co-existing species. The three minnow species were found to differ from each other in habitat, feeding behavior, organisms consumed, population age structure, and breeding habits. Mimic shiners occurred in large schools in shallow water and fed during the day, with peaks at dawn and dusk, on emerging and flying insects. They usually spawned in August but did not spawn at all in some years. Bluntnose minnows were found in small schools both in shallow water and in silty bottomed clearings in the aquatic vegetation in deeper water. They fed continuously on bottom organisms and detritus and spawned in July. Common shiners were roving opportunists, feeding on whatever organisms were most abundant. Their numbers fluctuated considerably but they were usually less abundant than the other two species. They spawned in June. All three cyprinids were ecologically segregated from the noncyprinid species in the lake as well. It was found that dietary studies can be reasonably good indicators of ecological differences if enough samples are taken at a variety of times and locations. (Auth.)

17346. Wold, Einar (Bur. of Sport Fish. & Wildl., Dworshak National Fish Hatchery, Ahsahka, Idaho 83520). 1973. SURFACE AGITATORS AS A MEANS TO REDUCE NITROGEN GAS IN A HATCHERY WATER SUPPLY. Prog. Fish-Cult., 35(3): 143-146.

Nitrogen supersaturation and its effect on fish (gas bubble disease) has been a problem in some fish hatchery operations for a number of years. At Dworshak National Fish Hatchery, surface agitators are used to reduce the level of nitrogen gas. Data obtained in this study indicated that agitation provided by surface aerators provides an excellent method for reducing supersaturation of nitrogen to levels acceptable for fish propagation. (Auth.)

17347. Wickham, Donald A. (Natl Marine Fish. Serv., Southeast Fisheries Center, Pascagoula, Mississippi 39567). 1973. ATTRACTING AND CONTROLLING COASTAL PELAGIC FISH WITH NIGHTLIGHTS. Trans. Amer. Fish. Soc., 102(4): 816-825.

Field experiments were conducted in the northeastern Gulf of Mexico to evaluate techniques for using sequentially-operated lamp strings and moving lamps to lead and concentrate light-attracted coastal pelagic fishes. Fish were successfully led between sequentially-operated underwater lamps separated by distances up to 20 meters. Mobile lamps were used to lead fish distances up to approximately 1 kilometer. Fish aggregations which form daily around man-made structures were held after dark and led clear with moving lamps for capture by purse seine. A combination of nightlighting and man-made structure fish attraction techniques are proposed for harvesting coastal pelagic fish aggregations which occur around existing petroleum drilling platforms, well heads, and other areas presently inaccessible to conventional fishing gear. (Auth.)

17348. Cure, V., A. Snaider, and I. Chiosila. 1970. MACROPHYTES FROM THE FRĂSINET POND (ILFOV PROVINCE) AND THEIR INFLUENCE ON THE LIFE OF THE ECOSYSTEM TWO YEARS AFTER THE INTRODUCTION OF THE SPECIES Ctenopharyngodon idella. Buletinul Institutului de Cercetari si Proiectari Piscicole, No. 29, pp. 5-27, Bucharest, Romania; Weed Abstracts, 22(8): p. 180, 1973.

Frăsinet pond was almost overgrown in 1967, 70% with fibrous emerged plants and 30% with soft submerged and floating plants. The pond was stocked in March-April 1968 with C. idella (grass carp) in their second year. Sampling in June 1969 showed that Scirpus lacustris, Najas marina, Potamogeton pectinatus and P. crispus had been eliminated and that the density of green Phragmites communis stems had been reduced from 110 to 83/m^2; Cicuta virosa had spread over an area of 1500 m^2. The total fresh wt. of aquatic vegetation decreased from >13,000 t in 1967 to 469 t in 1969, while the proportion of emerged plants increased from 83% to 97% of the total remaining vegetation. Submerged vegetation had been completely consumed by June 1969; the fish then fed on P. communis leaves and rhizomes. It was desirable to leave about 10-30% cover of submerged plants in the pond to oxygenate the water and provide nourishment for other organisms.

17349. Crossman, E. J., and G. E. Lewis (Dept. of Ichthyology and Herpetology, Royal Ontario Museum, 100 Queen's Park, Toronto, Canada). 1973. AN ANNOTATED BIBLIOGRAPHY OF THE CHAIN PICKEREL, Esox niger (OSTEICHTHYES: SALMONIFORMES). Royal Ontario Museum, Life Sciences Miscellaneous Publication, 81 p., price $2.50.

17350. Ossiander, Frank J., and Gary Wedemeyer (Natl Marine Fish. Serv., Biol. Lab., Biometrics Inst., Seattle, Washington 98102). 1973. COMPUTER PROGRAM FOR SAMPLE SIZES REQUIRED TO DETERMINE DISEASE INCIDENCE IN FISH POPULATIONS. J. Fish. Res. Bd. Canada, 30(9): 1383-1384.

A computer program is described for generating the sample size tables required in fish hatchery disease inspection and certification. The program was designed to aid in detection of infectious pancreatic necrosis (IPN) in salmonids, but it is applicable to any fish disease inspection when the sampling plan follows the hypergeometric distribution. (Authors)

17351. Kelley, John R., Jr. (Dept. of Wildl. and Fish. Sciences, Texas A&M Univ., College Station, Texas 77843). 1973. AN IMPROVED CAGE DESIGN FOR USE IN CULTURING CHANNEL CATFISH. Prog. Fish-Cult., 35(3): 167-169.

Cages were designed for use in experimental and production culture of fishes. Criteria associated with design were: durability, cost, and simplicity of construction. Cages were constructed of welded wire fabric and angle-iron frames. Cost of construction was $46 (including labor) for an expected 20-year use, with replacement of wire every 5 to 6 years at a cost of $8. (Auth.)

17352. Swift, Michael C., and Alice Y. Fedorenko (Dept. of Zool., Univ. of Br. Columbia, Vancouver, B. C., Canada). 1973. A RAPID METHOD FOR THE ANALYSIS OF THE CROP CONTENTS OF Chaoborus LARVAE. Limnology and Oceanography, 18(5): 795-798.

A fast, quantitative, direct method is described for determining the food of Chaoborus larvae by analyzing the contents of dissected crops. (Authors)

17353. Evelyn, T. P. T., G. E. Hoskins, and G. R. Bell (Fish. Res. Bd. of Canada, Pacific Biol. Sta., Nanaimo, British Columbia, Canada). 1973. FIRST RECORD OF BACTERIAL KIDNEY DISEASE IN AN APPARENTLY WILD SALMONID IN BRITISH COLUMBIA. J. Fish. Res. Bd. Canada, 30(10): 1578-1580.

A confirmed case of bacterial kidney disease in a sports-caught rainbow trout (Salmo gairdneri) from Loon Lake, British Columbia, is reported. The case represents the first record of this disease in an apparently wild fish in this province. Descriptions of the affected trout and of the causative bacterium are provided. (Authors)

17354. Wojno, Tadeusz, and Andrzej Wojciak (Akademia Rolniczo-Techniczna w Olsztynie, Instytut Rybactwa Srodladowego, Poland). 1973. UTILIZATION VALUE AND CHEMICAL COMPOSITION OF BODY OF RAINBOW TROUT BRED IN LIVE BOXES (Wartosc uzytkowa i sklad chemiczny ciala pstraga teczowego, wyprodukowanego w sadzach). Roczniki Nauk Rolniczych, 95(2): 111-118. In Polish.

Investigations comprised rainbow trout two years of age bred in live boxes, made of net, set in the lake Leginskie. Yields of edible parts (fillets) and the content of protein were found to be approximate in all the fish tested, irrespective of feeds applied and the sex of rainbow trout. The differences found were statistically insignificant. Fat content of rainbow trout body proved to depend on feeds applied and the sex of fish. (Authors' synopsis)

17355. Maki, Alan W., Kenneth W. Stewart, and J. K. G. Silvey (Dept. of Biol., No. Texas State Univ., Denton, Texas 76203). 1973. THE EFFECTS OF DIBROM ON RESPIRATORY ACTIVITY OF THE STONEFLY, Hydroperla crosbyi, HELLGRAMMITE, Corydalus cornutus AND THE GOLDEN SHINER, Notemigonus crysoleucas. Trans. Amer. Fish. Soc., 102(4): 806-815.

The respiratory activity of three aquatic animals, selected from different pollution index classifications, was examined in the presence of sublethal concentrations of Dibrom, a commonly used, broad spectrum, organophosphate insecticide. The oxygen consumption of Hydroperla crosbyi (Needham and Claassen), Corydalus cornutus L. and Notemigonus crysoleucas (Mitchill) was measured in a specially designed flowing-water respirometer, housed in an environmental chamber. The acute toxicity of Dibrom, measured as 24-hr LC_{50}'s for these animals, was compared in both static and flowing-water bioassays and found to be significantly more toxic to both the hellgramnites and stoneflies in the flowing system (LC_{50}: 6.8 ppm and 11.4 ppb, respectively) than in the static bioassay (LC_{50}: 9.5 ppm and 16.0 ppb, respectively). There was a marked difference in the toxicity of Dibrom to golden shiners between flowing and static systems but this was not statistically significant at the 95% confidence level. Sublethal Dibrom concentrations significantly affected oxygen consumption (QO_2) in all test animals, and reduced their tolerance to low oxygen tensions. The ability of the golden shiner to tolerate low oxygen tensions was reduced by 50% by exposure to 5 ppm Dibrom concentrations. Stonefly body undulations and hellgrammite gill beats were increased by exposure to sublethal toxicant levels in the flowing system. The flowing-water respirometer offers an approach to simulate the lotic environment in bioassays and laboratory assessments of the effects of pollutants on respiration and other organism responses. A standardization of technique is necessary to avoid the lengthy description of operation and methods which is now necessary before results can be reported. (Authors)

17356. Phillips, Raymond, and William J. Graveen (Bur. Sport Fish. & Wildl., Valley City Natl. Fish Hatchery, Valley City, No. Dakota 58072). 1973. A DOMESTIC MUSKELLUNGE BROODSTOCK. Prog. Fish-Cult., 35(3): 176-178.

17357. Argyle, Ray L., George C. Williams, and Harry K. Dupree (U. S. Bureau Sport Fish. & Wildl., Southeastern Fish Cultural Lab., Marion, Alabama). 1973. ENDRIN UPTAKE AND RELEASE BY FINGERLING CHANNEL CATFISH (Ictalurus punctatus). J. Fish. Res. Bd. Canada, 30(11): 1743-1744.

Fingerling channel catfish (Ictalurus punctatus) offered diets containing 0.04-4.0 μg endrin/g food (dry weight) rapidly accumulated the pesticide. Amounts in the tissues were directly proportional to amounts in the food. Dietary endrin had no measurable effect on growth or mortality. After endrin was withdrawn from the diet, it rapidly disappeared and could not be detected after 41 days. In fish exposed to 0.5 μg endrin/liter of water, mortalities began at tissue levels of 0.7 μg endrin/g of wet whole fish and total mortality occurred at levels near 1.0 μg/g. (Authors)

17358. Carlson, Anthony R., and John G. Hale (U.S. Environ. Protection Agency, Natl Water Qual. Lab., Duluth, Minnesota 55804). 1973. EARLY MATURATION OF BROOK TROUT IN THE LABORATORY. Prog. Fish-Cult., 35(3): 150-153.

Three photoperiods were tested in an effort to rear brook trout (Salvelinus fontinalis) to maturity as young-of-the-year and thus shorten the time necessary to complete a full chronic bioassay. The most successful test was with a photoperiod similar to the natural light sequence at Duluth, Minn. Hatchery brook trout were stripped on November 10, 1970; the embryos were incubated at 10°C and hatched completely in 52 days. Young-of-the-year were reared from January 15 to October 29 at 15°C. The water temperature was gradually lowered from 15°C on October 15 to 7.5° by November 24, 1971, where it remained until the test was ended. By February 2, 1972 (15 months after egg fertilization) 75 percent of the females and 98 percent of the males had reached functional maturity. (Authors)

17359. Barica, Jan (Fish. Res. Bd. of Canada, Freshwater Inst., Winnipeg, Manitoba R3T 2N6, Canada). 1973. RELIABILITY OF AN AMMONIA PROBE FOR ELECTROMETRIC DETERMINATION OF TOTAL AMMONIA NITROGEN IN FISH TANKS. J. Fish. Res. Bd. Canada, 30(9): 1389-1392.

The method involves an alkalization of a sample to pH 12 and subsequent measurement of liberated un-ionized ammonia with a gas-permeable membrane electrode. Total ammonia is measured directly rather than ammonium ion. Tests on different samples of water from aquaria and fish tanks showed a mean absolute difference of ±8.3% as compared with the phenolhypochlorite method in the concentration range of 0.5-5.1 mg/liter NH_3-N. The lowest level of detection was 0.1 mg/liter NH_3-N. (Auth.)

17360. Kawatski, Joseph A. (Dept. of Biol., Viterbo Coll., La Crosse, Wisconsin 54601). 1973. ACUTE TOXICITIES OF ANTIMYCIN A, BAYER 73, AND TFM TO THE OSTRACOD Cypretta kawatai. Trans. Amer. Fish. Soc., 102(4): 829-831.

Three toxicants were tested individually, and mixtures of two of them were tested for toxicity to freshwater ostracods (Cypretta kawatai) in laboratory static bioassays at 24 ± 1 C. The 96-hr LC50 values were: antimycin A (95.5%), 7.40 μg/l; TFM (95.7% 3-trifluormethyl-4-nitrophenol), 7.10 mg/l; Bayer 73 (70% 2-aminoethanol salt of 2', 5-dichloro-4'-nitrosalicylanilide), 1.16 mg/l. The toxicity of a 50:50 mixture of TFM and Bayer 73 was simply additive (96-hr LC50, 3.03 mg/l), whereas a 98:2 combination of TFM and Bayer 73 was slightly synergistic (96-hr LC50, 5.00 mg/l). (Auth.)

17361. Rommel, S. A., Jr. (Fish. Res. Bd. of Canada, Biol. Sta., St. Andrews, New Brunswick, Canada). 1973. APPARATUS FOR SIMULATING MOTION OF ANIMALS THROUGH THE GEOMAGNETIC FIELD. J. Fish. Res. Bd. Canada, 30(10): 1581-1582.

An apparatus to simulate animal motion through the geomagnetic field was devised. The test animal can be rotated through a magnetic field produced by two coils of wire. With this equipment biologists may introduce motionally induced electric fields into laboratory experiments on electro- and magneto-sensitivity. (Auth.)

17362. Plumb, John A., Lloyd D. Wright, and Virginia L. Jones (Dept. of Fish. and Allied Aquacultures, Agric. Exp. Sta., Auburn Univ., Auburn, Alabama 36830). 1973. SURVIVAL OF CHANNEL CATFISH VIRUS IN CHILLED, FROZEN, AND DECOMPOSING CHANNEL CATFISH. Prog. Fish-Cult., 35(3): 170-172.

Methods of storage were tested to determine the survival of virus in channel catfish (Ictalurus punctatus) killed by channel catfish virus (CCV). The virus was recovered from decomposing fish at 22°C for 2 days and from iced fish for 14 days. Virus survived for 162 days in fish frozen at -20°C and for 210 days in fish at -80°C. If living specimens cannot be examined immediately, fish intended for CCV assay should be frozen immediately and examined as soon as possible, or placed on ice for up to 2 weeks. (Authors)

17363. Feldmeth, C. Robert, and Thomas M. Jenkins, Jr. (Joint Sci. Dept., Claremont Colleges, Claremont, California 91711). 1973. AN ESTIMATE OF ENERGY EXPENDITURE BY RAINBOW TROUT (Salmo gairdneri) IN A SMALL MOUNTAIN STREAM. J. Fish. Res. Bd. Canada, 30(11): 1755-1759.

A method is presented which estimates energy expended by rainbow trout (Salmo gairdneri) in a natural stream habitat. Swimming speeds were determined by counting caudal fin beat frequency in the field. Published data on metabolic rates estimated in a water tunnel respirometer were then used to calculate energy expenditure. Swimming speeds and hence energy expenditure did not vary statistically for time of day or night (overall means: swimming speed, 16.1 cm/sec; energy expenditure, 736.5 cal/kg per hour). Our calculations indicate that swimming at 16 cm/sec would cost a 100-g rainbow trout 53 cal/hr at 15 C, and about 0.48 g (live weight) of natural food per 6 hr would be needed to offset the cost of swimming. (Authors)

17364. Andrews, James W., Takeshi Murai, and George Gibbons (Skidaway Inst. of Oceanogr. and Univ. of Georgia Coll. of Agric. Exp. Stations, Savannah, Georgia 31406). 1973. THE INFLUENCE OF DISSOLVED OXYGEN ON THE GROWTH OF CHANNEL CATFISH. Trans. Amer. Fish. Soc., 102(4): 835-838.

The long-term effects of three levels of dissolved oxygen (100, 60 and 36% of air saturation) on channel catfish, Ictalurus punctatus, were evaluated under two feeding regimes - a constant rate of 3% of biomass daily and ad libitum. At ad libitum rates (6-week duration) average gains of 159, 124, and 65 g per fish were obtained in tanks containing oxygen at 100, 60 and 36% of saturation, respectively. In both experiments food consumption and efficiency were drastically reduced at 36% oxygen saturation. Survival rates were 100% in all groups, thus suggesting that disease and parasite problems were not enhanced by a hypoxic environment. In these studies catfish did not demonstrate a polycythemic response to hypoxic conditions. (Authors)

17365. MacDonald, J. Rod, and R. A. Hyatt (Environ. Protection Serv., P. O. Box 2416, Halifax, Nova Scotia, Canada). 1973. SUPERSATURATION OF NITROGEN IN WATER DURING PASSAGE THROUGH HYDROELECTRIC TURBINES AT MACTAQUAC DAM. J. Fish. Res. Bd. Canada, 30(9): 1392-1394.

Two fish kills occurred at the Saint John River, New Brunswick, below the Mactaquac Hydroelectric Station in the summer of 1968. Gas bubbles, commonly associated with nitrogen supersaturation, were observed on dead and dying salmon (Salmo salar) and eels (Anguilla rostrata). Tests showed that the concentrations of dissolved oxygen and nitrogen gases were substantially increased when water passed through the turbine generating system at low generating levels. Concentrations of dissolved nitrogen gas increased by as much as 20% above atmospheric equilibrium. (Authors)

17366. Madison, D. M., A. T. Scholz, J. C. Cooper, R. M. Horrall, A. D. Hasler, and A. E. Dizon (Fish. Res. Bd. of Canada, Pacific Biol. Sta., Nanaimo, British Columbia, Canada). 1973. I. OLFACTORY HYPOTHESES AND SALMON MIGRATION: A SYNOPSIS OF RECENT FINDINGS. Fish. Res. Bd. Canada Technical Report No. 414, 35 p. Manuscript status.

Census and tracking experiments are presented with reference to the effect of morpholine on homing behavior. Related research and hypotheses are discussed also.

17367. Barnett, Brian S. (Fla. Game and Fresh Water Fish Comm., Ocala, Forida 32670). 1973. A TECHNIQUE FOR FISH POPULATION SAMPLING IN DENSE SUBMERSED VEGETATION. Prog. Fish-Cult., 35(3): 181-182.

A technique was devised for quantitative fish population sampling in dense growths of submersed aquatic plants using a miniature modification of the four sided block-off net. The net was constructed of fiberglass screen material and was designed to encompass an area of 100 ft^2. The maximum sampling depth was 3-1/2 ft. Fishes were recovered following removal of all vegetation within the sample area. This technique is not effective for large fishes which may be numerous around the periphery of dense vegetation, but it is highly effective for sampling within the plant beds which contain a large number and biomass of forage and juvenile game fishes. (Auth.)

17368. O'Connor, J. F., and G. Power (Dept. of Biol., Univ. of Waterloo, Waterloo, Ontario, Canada). 1973. TROUT PRODUCTION AND EELS IN BILL LAKE, SAGUENAY COUNTY, QUEBEC. J. Fish. Res. Bd. Canada, 30(9): 1398-1401.

Competition and predation by American eels (Anguilla rostrata) is believed to have substantially reduced trout population and production in Bill Lake. Brook trout (Salvelinus fontinalis) occurred at densities of 7/ha; biomass of 0.34 kg/ha and annual production was estimated at 0.21 kg/ha. This is considerably less than values for trout density, biomass, and production in other lakes in the Matamek watershed from which eels appear to be absent. Eels in Bill Lake are old and large but not numerous, in keeping with their apparent position as top carnivores. (Authors)

17369. Hickman, Gary D., and Michael R. Dewey (Dept. of Zool., Univ. of Ark., Fayetteville, Arkansas 72701). 1973. NOTES ON THE UPPER LETHAL TEMPERATURE OF THE DUSKYSTRIPE SHINER, Notropis pilsbryi, AND THE BLUEGILL, Lepomis macrochirus. Trans. Amer. Fish. Soc., 102(4): 838-840.

Sublethal, incipient upper lethal, and total lethal temperatures were obtained for the duskystripe shiner, Notropis pilsbryi, and the bluegill, Lepomis macrochirus. Both species were exposed to a gradual temperature increase of 2 C per day and to sudden temperature increases after being acclimated to a temperature of 21.5 C. Results indicate that the incipient upper lethal temperature of the bluegill, with a 2 C rise in temperature per day, is 35.5 C and that of the duskystripe shiner is approximately 32.0 C. Resistance times of both species to a sudden temperature increase were also determined. (Authors)

17370. Perry, W. Guthrie (La. Wildlife and Fish. Comm., Grand Chenier, Louisiana 70643). 1973. NOTES ON THE SPAWNING OF BLUE AND CHANNEL CATFISH IN BRACKISH WATER PONDS. Prog. Fish-Cult., 35(3): 164-166.

This report describes studies conducted on the effects of salinity on the reproduction of blue catfish (Ictalurus furcatus) and channel catfish (I. punctatus). It also documents the fact that both species spawned in coastal, brackish water ponds in salinities of approximately 2 ppt. (Auth.)

17371. Scherer, E., and S. Nowak (Dept. of the Environ., Fish. Res. Bd. of Canada, Freshwater Inst., Winnipeg, Manitoba R3T 2N6, Canada). 1973. APPARATUS FOR RECORDING AVOIDANCE MOVEMENTS OF FISH. J. Fish. Res. Bd. Canada, 30(10): 1594-1596.

An apparatus is described for continuous measurements of movements of fish exposed to chemical substances in a tank. A strip chart recording provides information on position and rate of movement of the test specimen during the experiment. (Authors)

17372. Smith, Lloyd L., S. I. Auerbach, John Cairns, Jr., Donald I. Mount, Gerard A. Rohlich, J. B. Sprague, and William L. Klein. 1973. ORSANCO 24-HOUR BIOASSAY. Ohio River Valley Water Sanitation Commission Report dated February 1, 1973, 13 p. + appendix.

17373. Hansen, Edward A. (U.S. Dept. of Agric., Forest Serv., No. Central Forest Exp. Sta., East Lansing, Mich. 48823). 1973. IN-CHANNEL SEDIMENTATION BASINS--A POSSIBLE TOOL FOR TROUT HABITAT MANAGEMENT. Prog. Fish-Cult., 35(3): 138-142.

Design and use of sedimentation basins for trout habitat management are discussed. Minimum basin size for trapping bedload sediments is based on Vetter's formula. Basins can remove essentially all moving bedload from a section of stream; whereas traditional "stream improvement' measures may decrease bedload sediments up to perhaps only 50%. Sediment reduction programs using basins will produce the maximum possible change in streambed composition. Basins are effective for trapping sand size and larger sediment and have the advantage that they could be located immediately upstream from critical zones such as spawning areas. (Auth.)

17374. Worthington, R. E., and R. T. Lovell (Dept. of Food Sci., Univ. of Ga. Coll. of Agric. Exp. Stations, Georgia Station, Experiment, Georgia 30212). 1973. FATTY ACIDS OF CHANNEL CATFISH (Ictalurus punctatus): VARIANCE COMPONENTS RELATED TO DIET, REPLICATIONS WITHIN DIETS, AND VARIABILITY AMONG FISH. J. Fish. Res. Bd. Canada, 30(10): 1604-1608.

Channel catfish (Ictalurus punctatus) grown on six experimental diets were analyzed for fatty acid composition of total lipid. Estimates of components of variance showed that natural variability in fatty acid composition among fish due to genetic and/or other factors accounted for 5.5% of total variance. Variance associated with diet, replication, and error accounted for 92.8, 0.7, and 1.0% of total variance, respectively. (Authors)

17375. Phinney, Duane E., and Stephen B. Mathews (Wash. Dept. of Fish., Olympia, Washington 98501). 1973. RETENTION OF FLUORESCENT PIGMENT BY COHO SALMON AFTER TWO YEARS. Prog. Fish-Cult., 35(3): 161-163.

A method of mass-marking fish that has become popular in recent years is the application of fluorescent pigment by compressed air. The longevity of the mark is not well defined, however; the longest period marked fish have been held is 6 months. As part of a larger experiment, coho salmon (Oncorhynchus kisutch) were marked at age 0 with either red, yellow, or green pigment. After 2 years in a relatively natural environment, marks had faded somewhat but were readily discernible. Average growth in length was about 160 mm. (Authors)

17376. Pitcher, T. J. (Dept. of Zool., Oxford Univ., England). 1973. SOME FIELD MEASUREMENTS ON MINNOW SCHOOLS. Trans. Amer. Fish. Soc., 102(4): 840-843.

A field technique is described for examining schools of fish by recording their times of capture during electrofishing. The technique is suitable for streams and rivers where the fish can be seen as they are caught. Analysis of the time intervals between minnow captures was carried out by fitting a mixture of gamma and exponential distributions. The results show that clusters of minnows are encountered at random during fishing. The clusters are considered equivalent to the schools in which minnows live in the wild, but the inadequacies of verbal recording preclude any biologically meaningful analysis of the within-cluster distributions. (Auth.)

17377. Krummrich, Jerry T., and Roy C. Heidinger (Fish. Res. Lab. and Dept. of Zool., Southern Illinois Univ., Carbondale, Illinois 62901). 1973. VULNERABILITY OF CHANNEL CATFISH TO LARGEMOUTH BASS PREDATION. Prog. Fish-Cult., 35(3): 173-175.

Various sizes of channel catfish (Ictalurus punctatus) were stocked into ponds containing 2-pound largemouth bass (Micropterus salmoides). Channel catfish 2 to 6 inches in length were vulnerable to bass predation, whereas 8-inch channel catfish were not eaten. Two-pound largemouth bass held in aquariums consumed catfish up to 7 inches in fork length. (Authors)

17378. Rabe, James R., Anthony A. Echelle, and H. E. Schlichting, Jr. (Univ. of Okla. Biol. Sta., Kingston, Oklahoma 73439). 1973. VIABILITY OF ALGAE IN THE DIGESTIVE TRACT OF TWO CYPRINODONTIDS. Prog. Fish-Cult, 35(3): 147-149.

Algae (green, bluegreen, and diatoms) occurred in 100% of the Cyprinodon rubrofluviatilis and Fundulus zebrinus that were examined. A total of 30 genera were cultured from the guts. There was no notable difference in floras of fore- and hindguts. Green and bluegreen algae seem to be indigestible, but evidence suggests that significant nutriment may be derived from diatoms. (Authors)

17379. Lusz, Larry D., and K. D. Waldron (Natl Marine Fish Serv., Northwest Fish. Center, Div. of Marine Fish and Shellfish, Seattle, Washington 98112). 1973. A PORTABLE WIRE-SPEED INDICATOR FOR USE WITH PLANKTON NETS. J. Fish. Res. Bd. Canada, 30(11): 1749-1751.

A system is described for measuring true wire speed during plankton tows, using commercially available electrical components attached to a standard metering wheel. The indicator increases uniformity between and during plankton tows where the wire speed does not exceed 50 m/min. (Authors)

17380. Weir, R. A., and R. W. McCauley (Ontario Ministry of Natural Resources, Ontario, Canada). 1973. INCUBATION OF LAKE TROUT EMBRYOS UNDER FLUORESCENT LIGHTS. Prog. Fish-Cult., 35(3): 179-180.

Practical trials were carried out in which lake trout (Salvelinus namaycush) eggs were incubated under four types of fluorescent lights -- blue, cool white, pink, and gold. At general hatchery illumination levels development was normal under each of the lights tested. (Authors)

17381. Stephens, Robert Rhea (Biol. Dept., Bradley Univ., Peoria, Illinois 61606). 1973. TWINNING IN Porichthys notatus Girard. Trans. Amer. Fish. Soc., 102(4): p. 846.

Three sets of twins hatched from 900 eggs of Porichthys notatus Girard. Two sets were immediately preserved. At no time during development did the third set differ significantly from nontwin larvae. Twinning probably occurred during cleavage. (Auth.)

17382. Zanella, Eugene F., and David L. Rades (The Inst. of Paper Chemistry, Appleton, Wisconsin 54911). 1973. A DISPOSABLE 20-LITER AQUARIUM WITH FLOW-THROUGH CAPABILITIES. Prog. Fish-Cult., 35(3): 182.

A stainless steel and Plexiglas framework which supports a heavy duty polyethylene bag was described. Flow-through capabilities were achieved by use of a bulkhead union to allow watertight passage of standard size tubing through the aquarium wall. This type of aquarium is inexpensive (approximately $7. each) and holds between 4 and 20 liters. (Authors)

17383. Shelton, William L. (Ala. Coop. Fish. Unit, Auburn Univ., Auburn, Alabama 36830). 1973. A DEVICE TO AID BOAT LAUNCHING AT PRIMITIVE LANDINGS. Prog. Fish-Cult., 35(3): 183.

Launching sites are often inadequate in the vicinity of desired sampling sites. A device is described which is temporarily attached to a boat trailer, making it more mobile, and permitting easier launching at primitive or unimproved access points. (Auth.)

17384. Wright, Sam, Mike Fraidenburg, and Richard Brix (Wash. Dept. of Fish., Olympia, Washington 98504). 1973. OBSERVATION AND MARKING OF JUVENILE CHINOOK SALMON IN THE HUMPTULIPS RIVER, WASHINGTON. Prog. Fish-Cult., 35(3): 154-156.

AUTHOR INDEX

Addison, R. F., 17185
Adron, J. W., 17272
Ahling, B., 17275
Akima, Reiko, 17242
Albrecht, Marie Luise, 17271
Albright, L. J., 17233
Allen, Donald M., 17164
Allen, John L., 17045, 17152
Allen, Richard L., 17176
Allendorf, Fred W., 17060
Amlacher, E., 17294
Andrews, James W., 17364
Andrews, Philip S., 17193
Antonini, E., 17296
Argyle, Ray L., 17357
Auerbach, S. I., 17372
Avery, Eddie L., 17052

Baeyens, D. A., 17290
Balakhnin, I. A., 17080
Bams, Robert A., 17324
Banner, Arnold, 17083
Barans, Charles A., 17318
Barber, R. T., 17138
Barber, Willard E., 17315
Barclay, Lee A., Jr., 17100
Barica, Jan, 17250, 17359
Barnett, Brian S., 17367
Barr, Louis, 17267
Beamish, F. W. H., 17279
Bell, G. R., 17353
Berger, Bernard L., 17129
Bergman, Harold L., 17169, 17274
Bern, Howard A., 17141
Bevan, Donald E., 17177, 17286
Bibor, V., 17325
Bidgood, B. F., 17304
Bilinski, E., 17337
Bjornn, Ted C., 17243
Blaxter, J. H. S., 17096
Bloom, Stephen E., 17120
Bond, Carl E., 17189, 17303
Bond, W. A., 17148
Bootsma, R., 17305
Born, Stephen, 17173, 17306
Bowen, R. H., 17316
Boyar, H. C., 17127
Brafield, A. E., 17207
Brannon, E. L., 17103
Brick, Edmund M., 17306
Brinkhurst, R. O., 17217
Brix, Richard, 17384
Broecker, Wallace, 17132
Brown, G. W., Jr., 17121
Brown, Harold G., 17043
Brown, J., 17088
Brown, V. M., 17228
Brungs, William A., 17111
Brunori, M., 17296
Burkhard, Walter T., 17253
Burrows, W. Dickinson, 17234
Burton, Dennis T., 17041
Butler, R. L., 17269

Cairns, John, Jr., 17036, 17181, 17218, 17372
Calamari, Davide, 17128
Cameron, James N., 17125
Capel, M., 17039
Carlson, Anthony R., 17358
Carter, J. C. H., 17106
Chapman, C. J., 17332
Chapman, G., 17038
Cheek, Randall P., 17264
Chen, Mao-song, 17159, 17226
Chenoweth, Harry H., 17330
Chevalier, John R., 17224
Childs, E. A., 17231
Chiosila, I., 17348
Chiszar, David, 17056
Chittenden, Mark E., Jr., 17108
Choi, P. M. K., 17175
Christian, L., 17110
Cimino, Michael C., 17328
Clarke, F. L., 17319
Clayton, John G., 17336
Clifford, R. A., 17127
Cobb, J. L. S., 17247
Coli, Sebastian J., 17134
Collins, H. L., 17212
Colombo, Lorenzo, 17141
Congdon, James C., 17157
Cooper, E. L., 17269
Cooper, J. C., 17320, 17366
Cordone, Almo J., 17260
Cosgrove, G. E., 17211
Cote, R. P., 17185
Coutant, C. C., 17172
Cowey, C. B., 17272
Crawshaw, L. I., 17270
Crim, Laurence W., 17109
Cristensen, G. M., 17334
Cross, F. A., 17138
Crossman, E. J., 17117, 17349
Crossman, John S., 17181
Curd, Milton R., 17194
Cure, V., 17348
Czerwinski, C. L., 17307

Dacre, J. C., 17323
Dahlke, L. W., 17053
Dangel, James R., 17295
Dashidorzhi, Anudarin, 17107
Davidoff, E. B., 17288
Davies, P. H., 17188
Davies, Robert B., 17253
Davis, J. R., 17212
Davis, John C., 17322

Davis, Robert M., 17114
Davy, F. B., 17146
Dawe, Donald L., 17265
Dawson, Verdel K., 17081
Deacon, James E., 17225
Delcroix, J. P., 17116
Dewey, Michael R., 17369
Dickson, K. L., 17218
Dizon, Andrew E., 17341, 17366
Dlugosz, Miroslawa, 17118
Doan, K. H., 17288
Dofuku, R., 17110
Donaldson, Edward M., 17109
Dorfman, Donald, 17338
Doudoroff, P., 17240
Douglass, Vaughn M., 17238
Dryfoos, Robert L., 17264
Dunn, James, 17204
Dunson, William A., 17054
Dupree, Harry K., 17357

Eaton, John G., 17105
Echelle, Anthony A., 17214, 17378
Eddy, F. B., 17281
Edwards, D. J., 17135
Egusa, Syuzo, 17067
Emerson, Steve, 17132, 17179
European Inland Fisheries Advisory Commission, 17048, 17095, 17112, 17163, 17186
Evelyn, T. P. T., 17353
Everhart, W. H., 17167, 17188

Falk, M. R., 17053, 17101
FAO of the UN, 17180, 17308
Fast, Arlo W., 17136
Fedorenko, Alice Y., 17352
Fee, Everett J., 17072, 17104, 17273
Feldmeth, C. Robert, 17363
Filatov, V. I., 17171
Fisher, Frank, 17050
Fisher, Stuart G., 17236
Fish. Res. Bd. Canada, 17182
Fleener, George G., 17166
Fletcher, G. L., 17147
Flickinger, R. A., 17162
Fox, N. C., 17247
Fraidenburg, Mike, 17384
Freeman, R. A., 17167
Fromm, Paul O., 17169, 17290, 17333
Frost, V. E., 17039, 17291
Funk, John L., (Editor), 17210

Gaffke, J. N., 17231
Gage, John, 17093
Galagan, N. P., 17080
Gard, Richard, 17170
Garside, E. T., 17151
Gas, Nicole, 17037
Gaygalas, K. S., 17317
Gesser, H., 17089
Giardina, B., 17296
Gibbons, George, 17364
Gibson, R. N., 17130
Gilderhus, Philip A., 17129
Gillman, D. V., 17053
Glooschenko, W. A., 17258
Grant, P. T., 17272
Gras, J., 17116
Gratzek, J. B., 17088, 17265
Graveen, William J., 17356
Gruchy, C. G., 17316
Gruchy, I. M., 17316

Haaker, Peter L., 17082
Hagen, D. W., 17068
Hale, John G., 17358
Hales, D. C., 17269
Hall, J. D., 17287
Hall, John W., 17036
Hambrick, Patrick S., 17200
Hamilton, R. D., 17219, 17259
Hammel, H. T., 17270
Hammond, Donald L., 17065
Hansen, Douglas R., 17071
Hansen, Edward A., 17373
Harada, Masayuki, 17242
Hardy, L. H., 17138
Harman, Paul D., 17129, 17152
Harmon, Keith W., 17092
Hashagen, Kenneth A., Jr., 17266
Hasler, A. D., 17245, 17320, 17341, 17366
Hathaway, Ronald P., 17063
Hauser, B. W., 17241
Havey, Keith A., 17193
Heath, Alan G., 17051
Heidinger, Roy C., 17377
Henderson, C., 17055
Henegar, Dale L., 17092
Henry, Kenneth A., 17187
Herlevich, John C., 17063
Hesselberg, R. J., 17274
Hesslein, R., 17179, 17230
Hibler, Charles P., 17253
Hickman, Gary D., 17369
Higley, Duane L., 17303
Hill, Loren G., 17214
Hirano, Tesuya, 17289
Hirose, Keiji, 17289
Hocutt, Charles H., 17200
Hodgins, Harold O., 17060
Hoffert, J. Russell, 17290
Hõgman, Walter J., 17329
Holden, A. V., 17293
Holway, Jamieson E., 17066
Horrall, R. M., 17245, 17341, 17366
Hoskins, G. E., 17353
Houde, E. D., 17035
Houston, A. H., 17307

Howell, W. Mike, 17120
Hughes, G. M., 17051, 17139
Hughes, Robert A., 17150
Huizinga, H. W., 17211
Hyatt, R. A., 17365

Ikeda, Shizunori, 17165, 17202
Ikeda, Yayoi, 17205, 17262, 17280
Inglis, A., 17055
Ishida, Rikizo, 17289
Islam, Md. Aminul, 17220, 17248
Ivey, C., 17110
Iwanago, P. M., 17287
Iwaszkiewicz, Michal, 17192, 17227

Jackivicz, Thomas P., Jr., 17086
Jenkins, Robert E., 17070
Jenkins, Thomas M., Jr., 17363
Jernelov, A., 17275
Johansson, N., 17216
Johnson, Donald W., 17141
Johnson, George N., 17183
Johnson, W. L., 17055
Jonas, R. E. E., 17337
Jones, N. Y., 17138
Jones, Roger, 17314
Jones, Virginia L., 17362
June, Fred C., 17043
Junell, Donald R., 17134

Kakino, Jun, 17159
Kan, Ting T., 17189
Kawai, Shin-ichiro, 17202
Kawatski, Joseph A., 17360
Kelley, John R., Jr., 17351
Kevern, Niles R., 17315
Kimmel, W. G., 17269
Kimura, Norihiko, 17058
Kleerekoper, H., 17140, 17146
Klein, William L., 17372
Kling, H., 17039
Knull, James R., 17267
Kolesnik, Yu. A., 17299
Kozlova, I. V., 17097
Krenkel, Peter A., 17234
Kroger, Richard L., 17264
Krogius, F. V., 17278
Krueger, Hugo M., 17285
Krummrich, Jerry T., 17377
Kuperman, B. I., 17208
Kuzminski, Lawrence N., 17086

Lackey, Robert T., 17201, 17238
Lande, A., 17061
Lander, Robert H., 17187
Landolt, M. L., 17237, 17331
Lanza, Guy, 17218
Lapin, V. I., 17195
Larmoyeux, Jack D., 17330
Larsson, A., 17216
Lau, J., 17233
Lawrence, M. J., 17101
Lean, D. R.S., 17310
Lee, D. J., 17133
Lee, G. Fred, 17150
Leray, C., 17325
Lewander, K., 17216
Lewis, G. E., 17349
Lewis, M. J., 17334
Likens, Gene E., 17236
Lister, N. A., 17340
Lloyd, R., 17293
Loch, J. S., 17252
Lotrich, Victor A., 17126
Lovell, R. T., 17232, 17321, 17374
Luhning, Charles W., 17152
Luke, D. McG., 17223
Lusz, Larry D., 17379

MacCrimmon, H. R., 17343
MacDonald, J. Rod, 17365
MacKinnon, J. C., 17339
MacLeod, J. C., 17252
Macy, Paul T., 17295
Madison, D. M., 17366
Maki, Alan W., 17355
Maksimov, V. A., 17074
Marak, R. R., 17127
Marchetti, Roberto, 17128
Markin, G. P., 17212
Marking, Leif L., 17081
Martin, Donald R., 17054
Marvin, Daniel E., Jr., 17041
Maslennikova, N. V., 17251
Mason, Barbara J., 17322
Massaro, Edward J., 17090, 17213
Mathews, Stephen B., 17375
Mathisen, Ole A., 17985
Matis, J. H., 17146
Matsuk, V. Ye, 17195
Matthiessen, P., 17207
McCauley, R. W., 17380
McCleave, James D., 17161
McErlean, A. J., 17076
McFarland, William N., 17164
McGlamery, Merrill H., 17265
McIntyre, J. D., 17249
McKim, J. M., 17334
McPhail, J. D., 17068
McQueen, A., 17178, 17335
Meekin, Thomas K., 17176
Meyer, Roland K., 17109
Minckley, Charles O., 17225
Mississippi State University, 17119
Molnar, K., 17122
Moodie, G. E. E., 17068
Moore, C. J., 17076
Moore, G. K., 17191
Moore, George A., 17194
Moore, J. E., 17258
Moore, Richard H., 17276
Morgan, Eric L., 17036

Morgan, Miriam, 17139
Morgan, Raymond P. II, 17263
Morrow, James E., 17094
Moul, Edwin T., 17199
Mount, Donald I., 17372
Moyle, Peter B., 17153, 17345
Munz, Frederick W., 17164
Murai, Takeshi, 17364

Nagai, Masanori, 17165
Nagiec, Maria, 17256
Newell, Arthur E., Jr., 17254
Nichols, Robert D., 17153
Nicholson, Bruce L., 17204
Nicol, J. A., 17145
Nicola, Stephen J., 17260
Noble, Richard L., 17297
Norling, Ingemar, 17142
Northcote, T. G., 17047
Nose, Yukio, 17220, 17248
Nowak, S., 17371

Obata, Takeshi, 17174
O'Connor, J. F., 17368
Ogawa, R., 17311
Ogino, Chinkichi, 17159, 17226
Ohno, S., 17110
Oloffs, P. C., 17233
Olson, Kenneth R., 17169, 17333
Ossiander, Frank J., 17350
Ozaki, Hisao, 17205, 17242, 17262, 17280

Palmieri, James R., 17168
Parker, Jack C., 17160
Parker, Michael, 17075, 17309
Pattie, Jack H., 17336
Pentreath, R. J., 17149
Perkins, F. E., 17127
Perrier, C., 17116
Perrier, Henri, 17116
Perry, W. Guthrie, 17370
Pessah, E., 17252
Peterka, J. J., 17156
Peterson, James O., 17173, 17306
Pettijohn, L. L., 17237
Phillips, Raymond, 17356
Phinney, Duane E., 17375
Pieprzyk, Julie, 17141
Pincock, D. G., 17223
Pinganaud-Perrin, G., 17215
Piper, Donald, 17204
Piper, Robert G., 17330
Pitcher, T. J., 17376
Pivazyan, S. A., 17326
Platts, William S., 17049, 17084, 17131
Plumb, John A., 17113, 17362
Pollard, Herbert A., II, 17243
Pontius, Richard W., 17309
Pope, G. F., 17106
Poston, Hugh A., 17164
Poupa, O., 17089
Power, G., 17106, 17368
Prokopowich, J., 17039
Przybyl, Antoni, 17227
Putnam, G. B., 17133

Quay, P., 17230
Quimby, M. C., 17237

Rabe, James R., 17378
Rades, David L., 17382
Rawstron, Robert R., 17184, 17229
Rehulka, J., 17261
Reid, R. A., 17039
Reimers, Paul E., 17102
Richardson, Sally L., 17221
Ricker, W. E., 17098
Ritter, J. A., 17343
Roberts, Ronald J., 17178, 17335
Rodriguez, L. V., 17162
Rogers, Philip M., 17301
Rohde, H., 17077
Rohlich, Gerard A., 17372
Romero, M., 17110
Rommel, Sentiel A., Jr., 17161, 17361
Rounsefell, George A., 17198
Rudd, John W. M., 17219
Ruf, H., 17077
Rybicki, R. W., 17288

Sackey, Lewis A., 17321
Saddler, James B., 17285
Sage, Martin, 17312
Saito, Tsuneyuki, 17174
Sand, O., 17332, 17344
Sano, Tokuo, 17209
Santer, R. M., 17247
Sawyer, L. D., 17313
Sawyer, Roy T., 17065
Scherer, E., 17371
Scherer, Michael D., 17239
Schindler, D. W., 17039, 17132, 17190, 17273, 17291
Schlichting, H. E., Jr., 17378
Schmidt, Dana C., 17196
Schmidt, R. V., 17039, 17291
Schneberger, Edward (Editor), 17210
Schneider, James C., 17046, 17059, 17091, 17144
Scholz, A. T., 17366
Schreck, Carl B., 17069
Schwartz, Robert J., 17143
Scott, D., 17323
Scott, Trudy, 17088, 17265
Scott, W. B., 17117
Seamans, Richard G., Jr., 17254
Senn, Harry G., 17336
Serfaty, Albert, 17037
Shearer, W. M., 17178, 17335
Shelton, William L., 17383

Shul'man, R. E., 17208
Shumway, D. L., 17240
Shuster, W. S., 17073
Silbergeld, Ellen K., 17078
Sills, Joe B., 17045, 17129, 17152
Silvey, J. K. G., 17355
Smith, Barry W., 17232
Smith, Charlie E., 17066
Smith, G. R., 17079
Smith, Lloyd L., Jr., 17268, 17372
Smith, R. J. F., 17044
Snaider, A., 17348
Sneed, K. E., 17302
Snelson, Franklin F., Jr., 17070
Solem, John O., 17064
Sparks, Richard E., 17036
Sprague, J. B., 17372
Spratt, Jerome D., 17123
Stainton, Michael P., 17057
Stasko, A. B., 17223, 17245
Stasko, D., 17245
Stauffer, Thomas M., 17235
Steele, D. H., 17298
Stephens, Robert Rhea, 17381
Stephenson, David A., 17173
Stevens, G. A., 17076
Stewart, Kenneth W., 17355
Stuart, C. J. S., 17314
Sutherland, Doyle F., 17283
Swenson, William A., 17268
Swift, Michael C., 17352
Szeto, S. Y., 17233

Tagatz, Marlin E., 17099
Tatum, Walter M., 17282
Taylor, Robert E. L., 17134
Tereshenkov, I. I., 17137
Tesarcik, J., 17261
Tett, P. B., 17093
Thompson, B. M., 17259
Tilly, L. J., 17277
Tinsley, Ian J., 17285
Tomlinson, Patrick K., 17154
Tramer, Elliot J., 17301
Trautman, Milton B., 17194
Trzebiatowski, Rajmund, 17292
Tubb, Richard A., 17318
Tucker, J. H., 17334
Tugarina, P. Ya., 17107
Turnbull, T. D., 17148
Turner, William R., 17183
Tyler, A. V., 17298
Tyus, Harold M., 17124

Uchida, Naoyuki, 17174
Uematsu, Kazuo, 17205, 17262, 17280
Uenishi, Eizaburo, 17262
U.S. Dept. of Comm., 17087
Ustyugov, A. F., 17040
Utter, Fred M., 17060

Van Arman, Joel A., 17083
Van Cleve, Richard, 17177, 17286
Van Meter, Harry D., 17115
Vestergard Jørgensen, P. E., 17155
Vincent, Robert E., 17042
Vladykov, Vadim D., 17062
Vlasenko, M. I., 17222
von Geldern, C. E., Jr., 17154

Wagner, C. C., 17269
Wagner, John F., 17075
Wakabayashi, Hisatsugu, 17067
Waldron, K. D., 17379
Wall, J. Peter, 17173
Wallace, Dale C., 17342
Waller, William T., 17036
Walter, Carl M., 17043
Walters, Carl J., 17042
Warren, C. E., 17240
Weber, L. J., 17196
Wedemeyer, Gary, 17350
Weihs, D., 17203
Weir, R. A., 17380
Wekell, Marleen M. B., 17121
Wells, Barbara, 17298
Westlake, Garson F., 17036
Wickham, Donald A., 17347
Wilde, Charles E., Jr., 17143
Wildish, D. J., 17340
Wilkens, E. Peter H., 17099
Wilkins, N. P., 17319
Willford, W. A., 17274
Williams, George C., 17357
Williams, I. V., 17244
Wilson, Robert P., 17158, 17206, 17246
Wilson, Stan, 17214
Windell, John T., 17056
Wirth, Thomas L., 17173, 17306
Withler, Fred C., 17295
Wojciak, Andrzej, 17354
Wojno, Tadeusz, 17327, 17354
Wold, Einar, 17346
Wolf, Ken, 17237, 17284
Woods, R. J., 17307
Worthington, R. E., 17374
Wright, Lloyd D., 17362
Wright, Sam, 17384
Wuensche, J., 17271
Wunsch, Carl, 17300
Wydoski, R. S., 17255

Yamane, Shinichi, 17197, 17257
Yamazaki, Takayoshi, 17209
Yarzhombek, A. A., 17251
Yasuda, Fujio, 17220, 17248
Young, H., 17178, 17335

Zanella, Eugene F., 17382
Zion, H. H., 17076
Zitko, V., 17175
Zyznar, E. S., 17145

SUBJECT INDEX

Age and growth,
anchovy, northern, in California reduction fishery, 1971-72, 17123
bluegill, re diet and temperature, 17046
catfish, channel, influence of D.O. on growth, 17364
fishes of first, second, and third order stream of East Kentucky, 17126
growth and metabolic rate in animals, mathematical analysis of, 17299
herring, larvae, in W. Atlantic, 1962-70, 17127
perch, re diet and temperature, 17046
salmon,
coho, effects of logging on, 17287
sockeye, young-, dynamics of growth in Lake Dalnee, 17278
trout,
brook, early maturation in laboratory, 17358
rainbow, re fin removal, 17260
steelhead, in North Pacific, 17283
whitefish, lake, divergent growth in two populations, 17304

Anatomy,
aberrant specimen of white perch, 17338
ambicoloration in some California flatfishes, 17082
black spots, number and pattern on rainbow trout body, 17248
eye ablation re morphogenesis of trout skull, 17215
eyes of three teleosts, reflecting materials in, 17145
gill structure re respiratory function, 17139
Lampetra minima n. sp., dwarf parasitic lamprey, description, 17189
length-weight relationship and condition of spot and croaker, Texas, 17160
liver, cytophysiology re changes after winter starvation of carp, 17037
morphological characteristics of European whitefish in Kurshyu-Mares, 17317
morphology of Siberian cisco from Yenisei basin, 17040
pyloric caeca,
fine structure of cells, rainbow trout, 17058
of chum salmon, inactive precursors of proteases in, 17174
skeletal anomalies in shad and blueback herring, 17239
skin, regeneration in carp, 17242
teeth, replacement in northern pike, 17137
Thymallus brevirostris, of Dzabkhan River basin, 17107

Bacteriology,
bacterial-kidney disease, first record in wild rainbow trout population, 17353
Edwardsiella tarda, re pond-cultured eel disease, 17067

Behavior,
attracting and controlling coastal pelagic fish with nightlights, 17347
avoidance movements of fish, apparatus for recording, 17371
behavioral regulation of internal temperature in brown bullhead, 17270
cannibalism as factor in first-year survival of Oneida walleye, 17224
diel rhythm of burbot young and fry, 17064
exploratory, of goldfish, effects of DDT on, 17146
homing of salmon, an electrophysiological approach, 17230
learning capacity of trout re food preferences, system for study, 17272
optimal cruising speed of fish, 17203
predation,
by bluegill on mealworm larvae, 17056
selective on Gasterosteus, experimental demonstration, 17068
response of yearling trout to black and white substrate, influence of experience, 17343
schools, minnow-, some field measurements on, 17376
vertical movements and light responses, monitoring in herring and plaice larvae, 17096

Benthos,
changes during artificial reservoir destratification, 17201
Chaoborus,
influence of fish on distribution and density, 17106
larvae, rapid method for analysis of crop contents, 17352
hellgrammite, effects of dibrom on, 17355
mysids, effects of stocking on Kootenay Lake and salmonids, 17047
of two lochs, log-normal statistics used to describe, 17093
oligochaetes, marine and brackish water, 17217
ostracods, toxicities of antimycin A, Bayer 73 and TFM to, 17360
stonefly, effects of dibrom on, 17355
stream-, influence of acid mine drainage on, 17114

Bibliography,
channelization,
and its environmental impact, 17092
of streams, symposium, 17210
ecology of Lake Washington drainage, annotated, 17255
freshwater fishes of Canada, 17117
hybridization, interspecific-, of salmonine fishes, 17295
pickerel, chain, 17349
pollution, effects on freshwater fish, 17334

Biocides,
insecticides,
chlorinated-hydrocarbon-, levels in commercial catfish, 17119
DDT,
effects on exploratory behavior of goldfish, 17146
PCB's in fish, recovery and quantitation, 17313
dibrom, effects on stonefly, hellgrammite, golden shiner, 17355
dieldrin,
chronic exposure of fish re adaptation to heat stress, 17078
effects on brown trout, 17323
endrin, uptake and release by catfish fingerlings, 17357
fenitrothion, biological effects in brook trout diet, 17340
mirex, residues in channel catfish and other organisms, 17212
pesticides, chlorinated-hydrocarbon-, 5-, factors affecting behavior in water and sediment, 17233
piscicides,
antimycin A, toxicity to ostracods, 17360
Bayer 73, toxicity to ostracods, 17360
TFM, toxicity to ostracods, 17360
toxaphene, accumulation in fish in treated lakes, 17150

Chemical factors,
acid water and fish extinction in southern Norway, 17061
ammonia N in fish tanks, ammonia probe for determination, 17359
anoxic water mass, temporary-, in Alaskan estuary, 17267
brackish ponds, spawning of blue and channel catfish in, 17370
carbon, procedure for determination in fresh water, 17057
carbonates, procedure for determination in fresh water, 17057
copper, re locomotor orientation of fish, 17140
heavy metals, effect on fish, 17038
mercury,
content in Oregon groundfish, 17231
in fish, sediments and water of Lake Oahe, So. Dakota, 17043
nitrogen gas in hatchery water, surface agitators for reduction, 17346
oxygen, dissolved,
development of criteria for freshwater fish, 17240
influence on channel catfish growth, 17364

Chemical factors, cont.
pH,
extremes re water quality criteria for European fish, 17095
survival of brook trout in bog-derived acidity gradient, 17054
phosphorus, movements between forms in lake water, 17310
radium 226, distribution and uptake in a sown lake, 17179
saline waters, effects on survival and ecology of fathead minnow, N. D., 17156
salinity tolerance of young American shad, 17108
sulfide, silver-sulfide electrode for standardization of solution in determination, 17250
water quality, development of monitoring system, 17036
zinc, dissolved, effects on stickleback gills, 17207

Chemicals,
alkylhydroxamic acids, toxicity to salmon fry re chain length, 17185
chlorinated dibenzofurans, oral toxicity to juvenile salmon, 17175
chlorine, residual-, effects on aquatic life, 17111
detergents, DBS- and TPS-, toxic effect on fishes, 17292
mercury determination in fish by neutron activation analysis, 17077
monohydric phenols, and inland fisheries, EIFAC report, 17163
PCB, metabolic effects on brown trout, 17216
PCB's and PCB's-DDT in fish, recovery and quantitation, 17313
quinaldine sulfate, preparation and properties, an improved fish anesthetic, 17045
sulfobromophthalein, metabolism and biliary excretion by trout, 17196
surfactant and metal mixtures, toxicity to rainbow trout, 17128
yellow-phosphorus-contaminated diet, acute toxicity to brook trout, 17147

Competition,
eels with trout in Bill Lake, Canada, 17368
food interrelationships of Lake Sevan trout and ludoga whitefish, 17326

Culture,
aquarium, disposable-, 20-liter-, with flow-through capabilities, 13382
cage-, of rainbow trout in brackish water, Alabama, 17282
catfish, channel,
absorption of earthy-musty compounds from blue-green algae, 17321
commercial production potential in Virginia, 17238
improved cage design, 17351
circular tanks, evaluation for salmonid production, 17330
diseases, fish-, handbook for veterinarians and biologists, 17294
FAO Aquaculture Bulletin, 17180
fin removal re survival and growth of rainbow trout, 17260
gravel incubators, evaluation on adult Tsolum River pink salmon, 17324
in-channel sedimentation basins, possible trout-habitat management tool, 17373
incubation of lake trout embryos under fluorescent lights, 13380
marine fish larvae, advances and problems, 17035
muskellunge, a domestic broodstock, 17356
pike, northern, *Saprolegnia* infections, 17305
quinaldine sulfate, toxicity to fish, 17081
Review of Fish. Res. Bd. of Canada, 1971-1972, 17182
salmonid feeds and feeding, 17112
Seriola quinqueradiata,
effects of iron-enriched diet in, 17280
Price-Jones curve in, 17262
surface agitators to reduce N gas in hatchery water, 17346
trout,
brook, early maturation in laboratory, 17358
rainbow,
egg characteristics and spawning season of, 17220
in live-boxes, chemical composition and utilization value, 17354
pellets made of fish offals tested for feeding, 17327

Culture, cont.
trout,
rainbow,
response to,
diet with varying protein/energy ratios, 17133
substrate re feasibility of conditioning for wariness, 17343
Washington pond trays as method for incubating salmon eggs and fry, 17336

Diet,
amino acid composition in proteins of dry feeds for carp and trout, 17271
ascorbic acid synthesis, absence in catfishes, 17246
composition re metabolism of acetate-U-^{14}C and L-alanine-U-^{14}C in carp, 17165
influence on fatty acid composition of catfish, 17374
iron-enriched-, effect in culture of Seriola, 17280
pellets made of fish offals, tested for rainbow trout feeding, 17327
produced changes in fatty acid content of coho salmon, 17285
protein,
digestibility in channel catfish feeds, determination, 17232
energy ratio variations, response of rainbow trout, 17133
salmonid feeds and feeding, 17112
yellow-phosphorus-contaminated-, acute toxicity to brook trout, 17147

Disease,
bacterial-kidney-, first record in wild rainbow trout population, 17353
bothriocephalosis, treatment with devermin, 17122
Calliobdella carolinensis, leech, epizootic on menhaden, 17065
catfish, channel, Poly I:C induces antiviral resistance, 17088
CCVD,
neutralization of virus by serum of channel catfish, 17113
use of microcultures of bullhead cells in quantitation of virus and antibody, 17265
cells, cultured-, FHM-, effect of temperature on division, RNA and protein synthesis, 17162
cytophysiology, of carp liver, changes after winter starvation, 17037
diplostomatosis,
electric current in prophylaxis of, 17222
in North Park, Colorado, 17253
diseases, fish-, handbook for veterinarians and biologists, 17294
Edwardsiella tarda, re pond-cultured eel disease, 17067
Hexamita salmonis, invasion of airbladder of trout, 17261
IHN virus isolation and identification in eastern N. America, 17237
incidence in populations, computer program for sample sizes required for determination, 17350
IPN,
of,
Oncorhynchus rhodurus macrostomus, 17209
rainbow trout in Montana, case report, 17066
virus,
immunofluorescent study of replication in cell-cultures, 17204
neutralizing antibodies in trout, nature and activity, 17155
lymphocystis, surface- and visceral-, in white crappie, 17211
Myxosoma cerebralis, trypsin method of isolation from fish skeleton, 17331
primary monolayer cell cultures from freshwater fishes, procedures, 17284
secondary infections associated with tagging of salmon, 17335
skeletal anomalies in shad and blueback herring, 17239
skin, regeneration in carp, 17242
tagging lesion in returning adult Atlantic salmon, 17178
whirling, attempts to control with continuous drug feeding, 17134
zinc, dissolved, effects on stickleback gills, 17207

Distribution,
Chaoborus, influence of fish on, 17106
depth-, of rainbow trout, effect of aeration of hypolimnion, 17136
fish populations of two streams entering a city area, 17301
fishes, in,
estuary of northwestern Florida, 17099
Newport River, North Carolina, 17183
flatfishes, young, on a sandy beach, 17130
freshwater fishes of Canada, 17117
herring, larvae, in W. Atlantic, 1962-70, 17127
larval fishes in Oregon waters, 1969, especially anchovy, 17221
macroinvertebrate-, factors influencing, 17315
marine-, 1965-66 brood of coho salmon from Columbia River hatcheries, 17187
menhaden, Gulf, in estuary of N.W. Florida, 17099
Percina crassa roanoka, in New River, Virginia, 17200
shiner,
colorless, from south-central United States, 17070
silver, first records from Canada, 17316
trout, steelhead, in N. Pacific, 17283

Drugs,
devermin, treatment of bothriocephalosis with, 17122
furazolidone, fed continuously to control whirling disease, 17134
gonadotropin, salmon-, effects on ovulation in ayu, especially re water balance, 17289
3H-testosterone uptake and influence of anti-antrogen in trout tissues, 17069
ni-furpirinol (P7138), for control of prespawning mortalities of sockeye, 17244
Poly I:C, induces antiviral resistance in channel catfish, 17088
quinaldine sulfate,
efficacy as anesthetic for freshwater fish, 17129
preparation and properties, an improved fish anesthetic, 17045
residue in ten fishes after anesthesia, 17152
toxicity to fish, 17081

Ecology,
channelization,
and impact, review of references, 17092
effects on fish and benthos of Little Sioux River, Iowa, 17071
of streams, symposium, 17210
characteristics of European whitefish in Kurshyu-Mares, 17317
cisco, Siberian, from Yenisei basin, 17040
community structure in pollution-receiving system, monitoring system for determining, 17218
copper re locomotor orientation of fish, 17140
diel rhythm of burbot young and fry, 17064
energy flow,
and production in unexploited plaice population, 17339
in N. H. brook, integrative approach to stream metabolism, 17236
estuarine-, harm from power-plant entrainment of fish, 17087
factors affecting macroinvertebrate distribution, 17315
fishes of,
first, second and third order stream of E. Kentucky, 17126
Sierra Nevada foothills, central California, 17153
Lake Washington drainage, annotated bibliography, 17255
lampreys, nonparasitic-, of N. America, reasons for protection, 17062
lead, toxicity to rainbow trout, and test of application factor concept, 17188
length-weight relationship and condition of spot and croaker, Texas, 17160
logging, effects on growth of coho salmon, 17287
minnow, fathead, North Dakota, effects of saline waters on, 17156
Review of Fish. Res. Bd. of Canada, 1971-72, 17182

Ecology, cont.
salmon,
Atlantic, in New Hampshire lakes, 17254
chinook, juvenile-, spring-, and production in a eutrophic reservoir, 17303
segregation among three species of minnows in a Minnesota lake, 17345
seismic exploration, its nature and effect on fish, 17101
South Fork Salmon River, Idaho, effects on logging and road-building, 17131
Thymallus brevirostris of Dzabkhan River basin, 17107
trout, Kamchatka, from Utkholok River, 17074

Economics,
cost of three strains of rainbow trout stocked in large Calif. lakes, 17229
evaluation of inland sport fishing, Sweden, 17142
potential of catfish production in Virginia, 17238
salmon, Atlantic, in New Hampshire lakes, 17254

Electricity,
electric,
current in prophylaxis of diplostomatosis, 17222
fields, oceanic-, prediction in relation to fish migration, 17161

Embryology,
blood-cell development in rainbow trout during embryonic growth, 17118
embryogeny of sea trout and beluga, dynamics of free amino acids in, 17251
eye ablation re morphogenesis of trout skull, 17215
fertilization and development in fish, effects of metals on, 17249
morphogenesis of mummichog, protein synthesis changes in, 17143
twinning in northern midshipman, 17381

Equipment,
ammonia probe for determination of ammonia N in fish tanks, 17359
apparatus for,
recording avoidance movements of fish, 17371
simulating motion of animals thru geomagnetic field, 17361
aquarium, disposable-, 20-liter-, with flow-thru capabilities, 17382
cage design, improved, for catfish culture, 17351
Carlo-Erba analyzer, modification for determination of C and N in suspended matter, 17241
circular tanks, evaluation for salmonid production, 17330
combustion-amalgamation technique for determination of Hg in fish, etc., 17274
device to aid boat launching at primitive landings, 17383
electron microprobe of trout gill tissue re Hg uptake and distribution, 17333
nightlights for attracting and controlling coastal pelagic fish, 17347
nylon- vs. cotton gill nets, efficiency in multispecies fishery, 17329
sampler for chemical analysis of fresh waters using evacuated tubes, 17314
silver-sulfide electrode for standardization of solution in determination of sulfide, 17250
surface agitators to reduce N gas in hatchery water, 17346
ultrasonic transmitter, pressure-sensing-, for tracking aquatic animals, 17223
Washington pond trays as method for incubating salmon eggs and fry, 17336
wire-speed indicator, portable-, for use with plankton nets, 17379

Estuary,
Bay of Fundy, intertidal feeding of winter flounder in, 17298
ecosystem, harm from entrainment of fish at power plants, 17087
Galveston Bay, Texas, length-weight relationship and condition of spot and croaker, 17160
in Alaska, a temporarily anoxic water mass, 17267
of N.W. Florida, occurrence of Gulf menhaden and other fishes, 17099
Patuxent, Maryland, sport fishing survey near power station, 17076

Fertilization,
artificially-enriched lake, heterotrophic utilization of sucrose in, 17259
effects on Kootenay Lake and salmonids, 17047
PO_4 and NO_3 addition to lake, 3-year results of eutrophication, 17039

Food habits,
carp, utilization of natural foods by larvae, 17171
Chaoborus larvae, rapid method for analysis of crop contents, 17352
consumption of small animals by 0-group grass carp, 17135
diet and temperature re food intake and growth of perch, bluegill, 17046
feeding, intertidal-, of winter flounder in Bay of Fundy, 17298
food preferences and behavior of trout re learning capacity, system for study, 17272
perch, yellow, re rate of digestion, 17059
pikeperch, European-, 3-year-olds from Jeziorak Lake, Poland, 17256
salmon, coho, stocked experimentally in N. Wisconsin lake, 17052
sauger, consumption, periodicity, digestion and conversion, 17268
trout, Lake Sevan-, 17326
walleye, consumption, periodicity, digestion and conversion, 17268
whitefish,
ludoga-, 17326
mountain, 17309

Genetics,
chromosomes and spermatozoa of mudminnow, sex-associated differential fluorescence, 17120
hybridization,
artificial-, intergeneric-, of rock bass, 17124
between Percina crassa roanoka and Percina oxyrhyncha, 17200
hybrids of cyprinids of western N. America, analysis, 17079
karyotypes and erythrocyte sizes of some diploids and triploids of Poeciliopsis, 17328
LDH and MDH isozymes of grayling, tissue distribution and properties, 17090
protein variations re relationships of Pacific salmon and trout, 17060
transferrin types in forms of carp, 17080
twinning in northern midshipman, 17381

Habitat improvement,
artificial aeration of hypolimnion, effect on distribution of trout, 17136
destratification, artificial-reservoir-, bottom fauna changes during, 17201
dilutional pumping for renewal from eutrophy, Snake Lake, Wis., 17173
gravel incubators, evaluation on adult Tsolum River salmon, 17324
in-channel sedimentation basins, possible trout-habitat management tool, 17373
Priest Rapids Spawning Channel for chinook salmon, evaluation, 17176
restoration of recreational potential of Marion Millpond, Wis., 17306
white amur,
a controversial biological control, 17302
for weed control in Lake Ösbysjön, 17275
stocking in pond, macrophytes re ecology after 2 years, 17348

Harvest,
angler catch rate from warmwater reservoirs, analysis of data, 17154
angling re abundance of juvenile steelhead trout, 17243
bluegill, model of response of population and fishery to exploitation and size limit, 17091
eel fishing gear and techniques, 17186
fishery,
and bluegill population of Mill Lake, response to increased growth, a model, 17144
investigations at Great Slave Lake, 17148

Harvest, cont.
inland sport fishing, economic evaluation, Sweden, 17142
mechanisms disallowing sustained peak-period yields from fish stocks, 17098
menhaden, Atlantic, 17264
nylon- vs. cotton gill nets, efficiency in multispecies fishery, 17329
salmon,
Atlantic, in New Hampshire lakes, 17254
coho, stocked experimentally in N. Wisconsin lake, 17052
sport-, of Great Bear and Great Slave Lakes, Canada, 17053
sportfishing-,
Platte River, Missouri, 17166
survey near power station of Patuxent Estuary, Maryland, 17076
trout, rainbow, tagged-, 3 strains stocked in large California lakes, 17229
unharvested fishes in commercial fishery of western Lake Erie, 1969, 17115

Identification,
carp, transferrin types in various forms, 17080
cisco, Siberian, from Yenisei basin, 17040
cyprinid hybrids of western N. America, analysis, 17079
eel, American, vs. European eel, 17110
freshwater fishes of Canada, 17117
gar, alligator, and list of associated species, Red River, Okla., 17194
grayling, LDH and MDH isozymes of grayling, tissue distribution and properties, 17090
higher marine shore plants of northeastern United States, 17199
Lampetra minima n. sp., dwarf parasitic lamprey, description, 17189
shiner, colorless, from south-central United States, 17070
Thymallus brevirostris, of Dzabkhan River basin, Mongolia, 17107
whitefish, European, morphological characteristics in Kurshyu-Mares, 17317

In vitro,
blood carbon dioxide of rainbow trout, 17281

Lake,
Azabach'ye, lipid metabolism in 2 forms of Arctic char, 17195
Bill, Canada, trout production re eels, 17368
Creran, Scotland, log-normal statistics used to describe benthos, 17093
Dalnee, USSR, population dynamics of growth of young sockeye, 17278
Erie, western,
temperatures selected seasonally by four fishes, 17318
unharvested fishes in commercial fishery, 1969, 17115
Etive, Scotland, log-normal statistics used to describe benthos, 17093
Gorzyn, Poland, observation of brown trout stocked in, 17192
Great Bear, Canada, 1972 sport fisheries, 17053
Great Lakes, causes for changes in phytoplankton dominance, 17311
Great Slave, Canada,
fishery investigations, 17148
1972 sport fisheries, 17053
Huron, surface distribution of chlorophyll a and primary production, 17258
Jeziorak, Poland, food habits of 3-year-old pikeperch, 17256
Kootenay, Canada, effects of mysid stocking and fertilization, 17047
Marion Millpond, Wis., restoration of recreational potential, 17306
Michigan,
fecundity of coho salmon, 17235
numerical model for determining primary production, 17072
Mill, response of bluegill population and fishery to,
exploitation and size limit, 17091
increased growth, a model, 17144
Oahe, So. Dakota, mercury in fish, sediments and water, 17043
Oneida-, cannibalism as factor in first-year survival of walleye, 17224
Ösbysjön, Sweden, weed control with grass carp, 17275

Lake, cont.
Pallette, Wis., experimental introduction of coho salmon, 17052
reservoir,
eutrophic-, ecology and production of juvenile spring chinook, 17303
Merle Collins, Calif., structure changes and yields in first 8 years, 17266
Ozero Ayatskoe, plankton as source of food for whitefish, 17097
warmwater-, analysis of angler catch rate from, 17154
Schoodic, Maine, population dynamics of hatchery-reared salmon, 17193
Snake, Wis., dilutional pumping for renewal from eutrophy, 17173
Superior, fecundity of coho salmon, 17235
Washington, annotated bibliography on ecology of drainage, 17255
Winnipeg, Canada, changes in lake whitefish population, 1944-1969, 17288

Life history,
freshwater fishes of Canada, 17117
pickerel, chain, bibliography, 17349
salmon, chinook, fall-, length of stay of juveniles in Sixes River, Ore., 17102
shiner, colorless, from south-central United States, 17070

Limnology,
ATP measurement in 2 Precambrian shield lakes of northwest Ontario, 17219
biogenic enrichment of sockeye lakes and stock productivity, 17085
C and N determination in suspended matter, modification for analyzer for, 17241
carbon,
dissolved-, inorganic-, variation and use re primary production and CO_2 invasion, 17273
procedure for determination in fresh water, 17057
carbonates, procedure for determination in sediments, 17057
destratification, artificial-reservoir-, bottom fauna changes during, 17201
dilutional pumping for renewal from eutrophy in Wisconsin lake, 17173
effects of mysid stocking and fertilization on Kootenay Lake and salmonids, 17047
epilithiphyton production in two experimental lakes, Canada, 17291
eutrophication of lake by PO_4 and NO_3 addition, 3-year results, 17039
experimental approaches - an overview, 17190
finely divided solids, criteria for European fish, 17048
gas-exchange rates in small lake, by radon method, 17132
heterotrophic utilization of sucrose in artificially enriched lake, 17259
hypolimnion, effect of artificial aeration on depth distribution of rainbow trout, 17136
mean drift in large lakes, 17300
nitrogen supersaturation in turbine water at dam, re fish kills, 17365
pH, extremes re water quality criteria for European fish, 17095
phosphorus, movements between forms in lake water, 17310
phytoplankton, causes for changes in dominance in Great Lakes, 17311
primary,
production in waters, numerical approach to modelling, 17104
productivity and limiting nutrients in small Wyoming lake, 17075
productivity,
comparative, of 4 Carolina lakes, 17277
potential-, of alpine lake, indicated by fish removal and restocking, 17042
radium 226, distribution and uptake in a sown lake, 17179
sampler for chemical analysis of fresh waters using evacuated tubes, 17314
surface distribution of chlorophyll *a* and primary production in Lake Huron, 17258
vertical eddy diffusion studies in thermocline of small stratified lake, 17230

Management,
artificial aeration of hypolimnion, effect on distribution of trout, 17136
bluegill population and fishery, model of response to exploitation and size limit, 17091

Management, cont.
coastal pelagic fishes, attracting and controlling with nightlights, 17347
destratification, artificial-reservoir-, bottom fauna changes during, 17201
dilutional pumping for renewal from eutrophy, Snake Lake, Wis., 17173
diseases, fish-, handbook for veterinarians and biologists, 17294
eel fishing gear and techniques, 17186
effects of mysid stocking and fertilization on Kootenay Lake and salmonids, 17047
entrainment of fish at power plants, harm to estuarine ecosystem, 17087
FAO Aquaculture Bulletin, 17180
fin removal re survival and growth of rainbow trout, 17260
lampreys, nonparasitic-, of North America, reasons for protection, 17062
outboard-motor pollution, review of effects on aquatic environment, 17086
Platte, Mo., recreational use of, 17166
quinaldine sulfate,
efficacy as anesthetic for freshwater fish, 17129
toxicity to fish, 17081
restoration of recreational potential of Marion Millpond, Wis., 17306
Review of Fish. Res. Bd. of Canada, 1971-72, 17182
salmon,
chinook, evaluation of Priest Rapids Spawning Channel, 17176
sockeye, causes of decline of Karluk run, recommendations, 17177
stocking of white amur in pond, macrophytes re ecology after 2 years, 17348
trout,
-habitat-, in-channel sedimentation basins as management tool, 17373
lake, in Great Bear and Great Slave Lakes, Canada, 17053
steelhead, effects of angling and hatchery trout on abundance, 17243
weed control by white amur, discussion, 17302
whitefish, European, fishery regulation in Kurshyu-Mares, 17317

Marking,
biological stains for fish eggs, 17263
fin removal re survival and growth of rainbow trout, 17260
fluorescent pigment, retention by coho after 2 years, 17375
salmon, chinook, juveniles in Humptulips River, Wash., 17384
tagging lesion in returning adult Atlantic salmon, 17178
tags,
3-, comparisons on 3 salmonids, 17184
Floy-, fingerling-, effects on small stream fishes, 17100
ultrasonic transmitter, pressure-sensing-, for tracking aquatic animals, 17223

Mathematics,
analysis of,
angler catch rate data from warmwater reservoirs, 17154
energy flow and production in unexploited plaice population, 17339
growth writings of Bertalanffy, Taylor and Vinberg, 17299
computer program for sample sizes required for determination of disease incidence in fish populations, 17350
estimate of energy expenditure by trout in small stream, 17363
log-normal statistics, used to describe benthos of 2 lochs, 17093
model,
numerical, for determining primary production, re Lake Michigan, 17072
of response of bluegill,
and fishery of Mill Lake to increased growth, 17144
population and fishery to exploitation and size limit, 17091
modelling of primary production of waters, numerical approach, 17104
optimal cruising speed of fish, 17203
statistical approach to diet-caused changes in fatty-acid content of coho salmon, 17285

Migration and movement,
coastal-, of mature Fraser River pink salmon, via ultrasonic tracking, 17245

Migration and movement, cont.
fish-, prediction of oceanic electric fields in relation to, 17161
homing of,
coho salmon, olfactory electroencephalographic responses to conspecific-conditioned water, 17341
salmon, an electrophysiological approach, 17320
intertidal-, and distribution of young flatfishes on a beach, 17130
locomotor orientation of fish, copper re, 17140
menhaden, Atlantic, 17264
salmon,
and steelhead, effects of heavy metals in Idaho drainage, 17084
olfactory hypotheses, synopsis of recent findings, 17366
sockeye,
"causes of decline in Karluk runs", comments on, 17198
fry, controlling mechanisms, 17103
reply to Rounsefell's comments on decline of Karluk run, 17286
travel time and influences in Karluk River, Alaska, 17170
ultrasonic transmitter, pressure-sensing-, for tracking aquatic animals, 17223
vertical-, and light responses, monitoring in herring and plaice larvae, 17096

Oceanography,
coastal pelagic fishes, attracting and controlling with nightlights, 17347
electric fields, oceanic-, prediction in relation to fish migration, 17161

Parasites,
bothriocephalosis, treatment with devermin, 17122
Calliobdella carolinensis, leech, epizootic on menhaden, 17065
Diplostomum spathaceum,
electric current in prophylaxis of, 17222
life cycle, North Park, Colorado, 17253
Ergasilus sieboldi, effect of temperature on, 17208
Gyrodactylus stableri, sp. n., and new records for gyrodactylids, 17063
Hexamita salmonis, invasion of airbladder of rainbow trout, 17261
in sea trout during stay on spawning grounds, 17227
Lampetra minima n. sp., dwarf parasitic lamprey, description, 17189
lamprey, sea, adult, oxygen consumption re weight and temperature, 17279
Myxosoma cerebralis, trypsin method of isolation from fish skeleton, 17331
Posthodiplostomum minimum, hosts and intraspecific variation, 17168
Saprolegnia, infections in pike culture, 17305
Triaenophorus nodulosus, effect of temperature on, 17208

Physical factors,
finely divided solids, criteria for European fish, 17048
geomagnetic field, apparatus for simulating motion of animals thru, 17361
light,
monitoring of responses in bluegill and plaice larvae, 17096
re diel rhythm of burbot young and fry, 17064
seismic exploration, its nature and effect on fish, 17101
temperature,
and,
swimming speed re O_2 consumption of snappers, 17276
weight re oxygen consumption of adult sea lamprey, 17279
-daylength combinations, 4, effects on ovogenesis of Red River pupfish, 17214
effect on some pike parasites, 17208
re,
digestion rate in yellow perch, 17059
food intake and growth of perch, bluegill, 17046
shock-, dose response of rainbow trout to, re predation vulnerability, 17172
upper-lethal-, of,
Atlantic salmon, 17151
shiner and bluegill, 17369

Physical factors, cont.
temperatures selected seasonally by 4 fishes of western Lake Erie, 17318
thermal stress, adaptation of fish to, re chronic dieldrin exposure, 17078

Physiology,
absorption of earthy-musty compounds from blue-green algae by catfish, 17321
activities in juveniles, 17202
amino acids, free-, dynamics in embryogeny of sea trout and beluga, 17251
aminotransferases and GDH, distribution in channel catfish tissue, 17158
amylase activity, localization in digestive organs,
of carp, via substrate film method, 17257
thru starch substrate film method, 17197
ascorbic acid synthesis, absence in catfishes, 17246
blood,
-cell development in rainbow trout during embryonic growth, 17118
CO_2 of rainbow trout in vitro, 17281
body weight re metal concentrations in muscle of bluefish and Antimora, 17138
cardiac and respiratory responses of fishes during hypoxia and recovery, 17041
cardiovascular,
and respiratory changes during heat stress in trout, 17051
-respiratory activity in recovery of fish from anesthesia and surgery, 17307
cells, cultured-, FHM-, effect of temperature on division, RNA and protein synthesis, 17162
chemical composition and utilization value of live-box rainbow trout, 17354
cyto-, of carp liver, changes after winter starvation, 17037
11-deoxycorticosteroids, biosynthesis by teleost ovaries, discussion of role, 17141
dieldrin, chronic exposure of fish re adaptation to heat stress, 17078
digestion rate in perch re size, food and temperature, 17059
effects of Cd and Cu on lactate oxidation by trout gills, 17337
electrophysiological approach to salmon homing, 17320
endrin, uptake and release by catfish fingerlings, 17357
energy expenditure of rainbow trout in small stream, 17363
enzymes, digestive-, of trout after hatching; diet re enzyme activities in juveniles, 17202
erythrocytes, size and shape in herring, 17319
evacuation rates of young yellow perch, 17297
fatty acid content of coho salmon, diet-caused changes, 17285
fatty acids, variability in catfish re diet and individuals, 17374
fecundity of coho salmon from Lakes Michigan and Superior, 17235
gill structure re respiratory function, 17139
3-H-testosterone uptake and influence of antiandrogen in trout tissues, 17069
hearing in two flatfishes, field studies, 17332
hemoglobins, trout-, structural and functional properties, 17296
hydrocarbon, chlorinated, levels in commercial catfish, 17119
inactive precursors of proteases in pyloric caeca of chum salmon, 17174
LDH,
and MDH isozymes of grayling, tissue distribution and properties, 17090
isozymes of bloater, distribution, immunochemistry and MW, 17213
system in heart and skeletal muscle of fish, 17089
trout-, influence of oxygen on, 17290
lipid metabolism, in 2 forms of Arctic char from Lake Azabach'ye, 17195
mercury,
combustion-amalgamation technique for determination in fish, etc., 17274
content in Oregon groundfish, 17231
determination in fish by neutron activation analysis, 17077
residues in fish, 1969-70, NPMP, 17055
uptake and distribution in rainbow trout gills, via electron microprobe, 17333
metabolic rate and growth in animals, mathematical analysis, 17299

Physiology, cont.
metabolism of,
acetate-U-^{14}C and L-alanine-U-^{14}C in carp, re dietary composition, 17165
iodine and thyroxine in yellow perch, 17325
methyl mercuric chloride, uptake pathways in trout, 17169
methylmercury-203, uptake and loss by bluegill, 17234
mirex, residues in channel catfish and other organisms, 17212
N metabolism in catfish, apparent incomplete ornithine-urea cycle, 17206
nitrogen excretions of carp, determination, 17159
olfactory,
electroencephalographic responses of homing coho to conspecific-conditioned water, 17341
hypotheses and salmon migration, synopsis of recent findings, 17366
optimal cruising speed of fish, 17203
ornithine aminotransferase of fishes, 17121
ovogenesis of pupfish, effects of 4 temperature-daylengths on, 17214
ovulation in ayu, effects of salmon gonadotropin on, especially re water balance, 17289
oxygen,
consumption of,
adult sea lamprey re weight and temperature, 17279
snappers re temperature and swimming speed, 17276
dissociation and content of blood from burbot, pike, grayling, 17125
PCB, metabolic effects on brown trout, 17216
PCB's and PCB's-DDT in fish, recovery and quantitation, 17313
periodicity, food consumption, digestion, and conversion in walleye, sauger, 17268
pituitary content of prolactin re blood Na in mullet moved from sea- to fresh water, 17312
plasma,
gonadotropin levels in pink salmon, radioimmuno-assay estimates, 17109
proteins of rainbow trout, classification by various methods, 17116
Price-Jones curve in cultured yellowtail, 17262
protein,
digestibility in,
carp, apparent and true, 17226
channel catfish feeds, determination, 17232
synthesis changes in mummichog during morphogenesis, 17143
variations re relationships of Pacific salmon and trout, 17060
quinaldine sulfate, residue in 10 fishes after anesthesia, 17152
reflecting materials in eyes of 3 teleosts, 17145
regeneration of skin in carp, 17242
Ringer solution specific for plaice, 17247
saccular microphonic potentials in perch, recordings of, 17344
salmonid feeds and feeding, 17112
serum iron level and total iron binding capacity in cultured fishes, 17205
sex-associated differential fluorescence of mudminnow chromosomes and spermatozoa, 17120
sulfobromophthalein, metabolism and biliary excretion by trout, 17196
teeth, replacement in northern pike, 17137
testosterone eliminates alarm substance in male fathead minnows, 17044
toxaphene accumulation in fish in treated lakes, 17150
transferrin types in forms of carp, 17080
visual pigments of trout, changes in, 17164
zinc, dissolved, effects on stickleback gills, 17207
^{65}Zn and ^{54}Mn accumulation and retention by plaice, 17149

Plankton,
algae,
blue-green-, absorption by catfish of earthy-musty flavor compounds from, 17321
viability of, in gut of 2 cyprinodontids, 17378

Plankton, cont.
in Russian reservoir, as source of food for whitefish, 17097
ostracods, toxicities of antimycin A, Bayer 73 and TFM to, 17360
phyto-, causes for changes in dominance in Great Lakes, 17311
utilization by carp larvae, 17171

Pollution,
acid mine,
drainage, influence on stream benthos and fish, 17114
waters, fish and food organisms in, Pennsylvania, 17269
alkylhydroxamic acids, toxicity to salmon fry re chain length, 17185
aluminum, aqueous, toxic effects to rainbow trout, 17167
biogenic enrichment of sockeye lakes and stock productivity, 17085
BKME, procedures for acute toxicity to salmon, 17322
cadmium, effects on lactate oxidation by trout gills, 17337
chlorinated,
dibenzofurans, oral toxicity to juvenile salmon, 17175
hydrocarbons, 5-, factors affecting behavior in water and sediment, 17233
chlorine, residual-, effects on aquatic life, 17111
copper, effects on lactate oxidation by trout gills, 17337
detergents, DBS- and TBS-, toxic effect on fishes, 17292
dibrom, effects on stonefly, hellgrammite, golden shiner, 17355
dieldrin,
chronic exposure of fish re adaptation to heat stress, 17078
effects on brown trout, 17323
effects on freshwater fish, 17334
endrin, uptake and release by catfish fingerlings, 17357
fenitrothion, biological effects in brook trout diet, 17340
finely divided solids, criteria for European fish, 17048
heavy metals,
effect on fish, 17038
effects on salmonid runs in Idaho drainage, 17084
lead, toxicity to rainbow trout, and test of application factor concept, 17188
logging,
and roadbuilding, effects on South Fork Salmon River, Idaho, 17131
effects on growth of coho salmon, 17287
marine-, directory of experts on, 17308
mercury,
combustion-amalgamation technique for determination in fish, etc., 17274
content of Oregon groundfish, 17231
determination in fish by neutron activation analysis, 17077
in fish, sediments and water of Lake Oahe, So. Dakota, 17043
residues in fish, 1969-70, NPMP, 17055
metals,
and surfactants, toxicity of mixtures to rainbow trout, 17128
effects on fertilization and development in fish, 17249
methylmercury-203, uptake and loss by bluegill, 17234
monitoring system, for determining community structure in receiving systems, 17218
monohydric phenols, and inland fisheries, EIFAC report, 17163
nature and extent of problems affecting European inland fisheries, 17293
oil-induced mortalities in juvenile coho and sockeye, 17094
Orsanco 24-hour bioassay, 17372
outboard,
-engine exhaust-, control, 17073
-motor-, review of effects on aquatic environment, 17086
oxygen, dissolved, development of criteria for freshwater fish, 17240
petroleum refinery effluents, acute toxicity to fish, 17252
pH, extremes re water quality criteria for European fish, 17095
power-plant effluent, pH neutralization of, effect on Clinch River, Va., 17181
sediment in a salmon-steelhead environment, 17049

Pollution, cont.
seismic exploration, its nature and effect on fish, 17101
streams, 2-, entering metropolitan area, distribution and abundance of fishes, 17301
thermal effects on bluegill eggs, larvae and juveniles, 17083
toxaphene, accumulation in fish in treated lakes, 17150
water-,
administrative action as control, 17191
quality, development of monitoring system, 17036
yellow phosphorus-contaminated diet, acute toxicity to brook trout, 17147

Populations,
bluegill,
and fishery of Mill Lake, response to increased growth, a model, 17144
model of response to exploitation and size limit, 17091
cisco, Siberian, from Yenisei basin, 17040
disease incidence in, computer program for sample sizes required for determination, 17350
fish,
and benthos, influence of acid mine drainage on, in streams, 17114
of,
channelized and unchannelized parts of Chariton River, Mo., 17157
2 streams entering metropolitan area, distribution and abundance, 17301
sampling technique in dense submerged vegetation, 17367
fishes in Newport River, No. Carolina, distribution and abundance, 17183
larval fishes in Oregon waters, 1969, especially anchovy, 17221
menhaden, Atlantic, 17264
plaice, analysis of energy flow and production in absence of exploitation, 17339
salmon,
Atlantic, in New Hampshire lakes, 17254
coho, 1965-66 brood-, from Columbia River hatcheries, maturity and abundance, 17187
landlocked, hatchery-reared-, dynamics in Schoodic Lake, Maine, 17193
sockeye, dynamics of growth of young in Lake Dalnee, 17278
structure changes and yields in first 8 years of reservoir, 17266
trout,
hatchery-, effects on abundance of juvenile steelhead trout, 17243
steelhead, seasonal abundance in North Pacific, 17283
whitefish,
European, structure and state of stocks in Kurshyu-Mares, 17317
lake,
changes in Lake Winnipeg from 1944 to 1969, 17288
2, divergent growth, 17304

Predation,
bass, largemouth, vulnerability of channel catfish to, 17377
bluegill on mealworm larvae, 17056
eels on trout in Bill Lake, Canada, 17368
selective-, on Gasterosteus aculeatus, experimental demonstration, 17068
vulnerability of rainbow trout, re dose response to 3 shock temperatures, 17172

Production,
and energy flow in unexploited plaice population, 17339
catfish, channel commercial-production potential in Virginia, 17238
channelization of streams, symposium, 17210
epilithiphyton in 2 experimental lakes, Canada, 17291
fishes of first, second, and third order stream of E. Kentucky, 17126
menhaden, Atlantic, 17264
primary-,
and limiting nutrients in small Wyoming lake, 17075
in Lake Huron, and surface distribution of chlorophyll a, 17258
in waters, numerical approach to modelling, 17104

Production, cont.
primary-, cont.
numerical model for determining, re Lake Michigan, 17072
productivity,
comparative, of 4 Carolina lakes, 17277
potential-, of alpine lake, indicated by fish removal and restocking, 17042
salmon,
chinook, juvenile-, spring-, and ecology in eutrophic reservoir, 17303
sockeye,
biogenic enrichment of lakes and stock productivity, 17085
causes of decline of Karluk run, recommendations, 17177
trout-, re eels in Bill Lake, Canada, 17368

Radiobiology,
radioimmunoassay estimates of plasma gonadotropin levels in pink salmon, 17109
radium 226, distribution and uptake in a sown lake, 17179
ultrasonic,
tracking of coastal movements of mature Fraser River pink salmon, 17245
transmitter, pressure-sensing-, for tracking aquatic animals, 17223
^{65}An and ^{54}Mn accumulation and retention by plaice, 17149

Reproduction,
bluegill, thermal effects on bluegill eggs, larvae and juveniles, 17083
egg characteristics and spawning season of rainbow trout, 17220
fecundity of coho salmon from Lakes Michigan and Superior, 17235
fertilization and development in fish, effects of metals on, 17249
gravel incubators, evaluation on adult Tsolum River salmon, 17324
minnow, silverjaw, 17342
ovulation in ayu, effects of salmon gonadotropin on, especially re water balance, 17289
pupfish,
Devils Hole, observations on reproductive cycle, 17225
Red River, effects of 4 temperature-daylength combinations on ovogenesis, 17214
spawning,
evaluation of Priest Rapids Channel for chinook salmon, 17176
of,
blue and channel catfish in brackish ponds, 17370
Mississippi silversides, 17050

Research,
alkylhydroxamic acids, toxicity to salmon fry re chain length, 17185
aluminum, aqueous, toxic effects to rainbow trout, 17167
amino acids, free-, dynamics in embryogeny of sea trout and beluga, 17251
antimycin A, toxicity to ostracods, 17360
apparatus for simulating motion of animals thru geomagnetic field, 17361
ascorbic acid synthesis, absence in catfishes, 17246
Bayer 73, toxicity to ostracods, 17360
bioassay procedures for acute toxicity of BKME to salmon, 17322
carbon,
and N determination in suspended matter, modification of analyzer for, 17241
procedure for determination in fresh water, 17057
carbonates, procedure for determination in sediments, 17057
cells, cultured-, FHM-, effect of temperature on division, RNA and protein synthesis, 17162
channelization effects on fish and benthos of Little Sioux River, Iowa, 17071
chlorinated dibenzofurans, oral toxicity to juvenile salmon, 17175
chlorine, residual-, effects on aquatic life, 17111
culture of marine fish larvae, advances and problems, 17035
detergents, DBS- and TBS-, toxic effect on fishes, 17292
dibrom, effects on stonefly, hellgrammite, shiner, 17355

Research, (cont.)
dieldrin,
chronic exposure of fish re adaptation to heat stress, 17078
effects on brown trout, 17323
diet and temperature re food intake and growth of perch, bluegill, 17046
diseases, fish-, handbook for veterinarians and biologists, 17294
effects of,
Cd and Cu on lactate oxidation by trout gills, 17337
mysid stocking and fertilization on Kootenay Lake and salmonids, 17047
electric fields, oceanic-, prediction in relation to fish migration, 17161
endrin, uptake and release by catfish fingerlings, 17357
eutrophication of lake by PO_4 and NO_3 addition, 3-year results, 17039
FAO Aquaculture Bulletin, 17180
fenitrothion, biological effects in brook trout diet, 17340
finely divided solids in water, criteria for European fish, 17048
gas-exchange rates in small lake, by radon method, 17132
3H-testosterone uptake and influence of antiandrogen in trout tissues, 17069
heavy metals, effect on fish, 17038
homing of salmon, an electrophysiological approach, 17320
hydrocarbon, chlorinated, levels in commercial catfish, 17119
lead, toxicity to rainbow trout and test of application factor concept, 17188
limnological-, experimental approaches - an overview, 17190
mercury,
combustion-amalgamation technique for determination in fish, etc., 17274
content in Oregon groundfish, 17231
determination in fish by neutron activation analysis, 17077
in fish, sediments and water of Lake Oahe, So. Dakota, 17043
residues in fish, 1969-70, NPMP, 17055
uptake and distribution in trout gills, via electron microprobe, 17333
metals,
and surfactants, toxicity of mixtures to rainbow trout, 17128
effects on fertilization and development in fish, 17249
methyl mercuric chloride, uptake pathways in trout, 17169
methylmercury-203, uptake and loss by bluegill, 17234
mirex, residues in catfish and other organisms, 17212
modelling of primary production of waters, numerical approach, 17104
ni-furpirinol (P7138), for control of prespawning mortalities of sockeye, 17244
nitrogen excretions of carp, determination, 17159
oil-induced mortalities in juvenile coho and sockeye, 17094
Orsanco 24-hour bioassay, 17372
outboard-,
engine exhaust pollution, control, 17073
motor pollution, review of effects on aquatic environment, 17086
oxygen, dissolved, development of criteria for freshwater fish, 17240
PCB, metabolic effects on brown trout, 17216
PCB's and PCB's-DDT in fish, recovery and quantitation, 17313
pesticides, chlorinated-hydrocarbon-, 5-, factors affecting behavior in water and sediments, 17233
petroleum refinery effluents, acute toxicity to fish, 17252
pH, extremes re water quality criteria for European fish, 17095
protein digestibility in catfish feeds, determination, 17232
quinaldine sulfate,
efficacy as anesthetic for freshwater fish, 17129
preparation and properties, an improved fish anesthetic, 17045
residue in 10 fishes after anesthesia, 17152
toxicity to fish, 17081
Review of Fish. Res. Bd. of Canada, 1971-72, 17182
Ringer solution specific for plaice, 17247
salmonid feeds and feeding, 17112
sampler for chemical analysis of fresh waters using evacuated tubes, 17314
sulfide determination in water, silver-sulfide for standardization of solution, 17250

Research, (cont.)
sulfobromophthalein, metabolism and biliary excretion by trout, 17196
temperature, upper-lethal-, of Atlantic salmon, 17151
TFM, toxicity to ostracods, 17360
thermal effects on bluegill eggs, larvae and juveniles, 17083
toxaphene accumulation in fish in treated lakes, 17150
toxicity,
chronic, of Cu-Cd-Zn mixture to fathead minnow, 17105
testing of substances to fish, concepts and outlook, 17228
vertical movements and light responses, monitoring in herring and plaice larvae, 17096
visual pigments of trout, changes in, 17164
water quality, development of monitoring system, 17036
white amur,
a controversial biological control, 17302
stocking, macrophytes re ecology after 2 years, 17348
yellow phosphorus contaminated diet, acute toxicity to brook trout, 17147
zinc, dissolved, effects on stickleback gills, 17207

River,
Bear Brook, N. H., energy flow in, integrative approach to stream metabolism, 17236
Chariton, Mo., fish populations of channelized and unchannelized parts, 17157
Clinch, Va., effect of pH neutralization of power plant effluent, 17181
Dzabkhan, Mongolia, grayling of, 17107
Fraser,
ni-furpirinol (P1738) for control of prespawning mortalities of sockeye, 17244
ultrasonic tracking of coastal movements of mature pink salmon, 17245
Humptulips, Wash., observation and marking of chinook juveniles, 17384
Karluk, Alaska,
causes of decline of sockeye run, recommendations, 17177
travel time and influences for migrating sockeye, 17170
Little Sioux, Iowa, effects of channelization on fish and benthos, 17071
Matamek, system, Canada, influence of fish on distribution and density of Chaoborus, 17106
Newport, No. Carolina, distribution and abundance of fishes, 17183
Platte, Missouri, recreational use, 17166
Red, Oklahoma, description of alligator gar and list of associated species, 17194
Saint John, Canada, N supersaturation in turbine water re fish kills, 17365
Sixes, Oregon, length of stay of juvenile fall chinook, 17102
South Fork Salmon, Idaho,
effects of logging and roadbuilding, 17131
sediment in a salmon-steelhead environment, 17049
stream channelization, symposium, 17210
Tsolum, Canada, evaluation of gravel incubators on adult salmon, 17324
Utkholok, USSR, ecological data on Salmo mykiss, 17074

Sampling,
fish populations,
for disease incidence, computer program for sample sizes required, 17350
in dense submerged vegetation, 17367
of 2 streams entering city area, distribution and abundance, 17301

Specific,
amur, white, 17275, 17302, 17348
anchovy,
bay, 17145
northern, 17123, 17221
Antimora rostrata, 17138

Specific, cont.
bass,
largemouth, 17140, 17153, 17266, 17377
rock, 17124
smallmouth, 17318
striped, 17263
white, 17318

Specific, cont.
bloater, 17213
bluefish, 17138
bluegill, 17038, 17041, 17046, 17056, 17083, 17091, 17144, 17153, 17154, 17197, 17234, 17266, 17369
bullhead, brown, 17041, 17265
burbot, 17064, 17125
carp, 17037, 17080, 17159, 17165, 17171, 17205, 17226, 17242, 17257, 17271, 17292, 17307
grass, 17135
catfish, 17119
blue, 17246, 17370
channel, 17088, 17113, 17140, 17158, 17206, 17212, 17232, 17238, 17246, 17321, 17341, 17357, 17362, 17364, 17370, 17374, 17377
char, Arctic, 17195
chiselmouth X shiner, redside, 17079
chub, creek, 17301
cisco,
Arctic, 17101
Siberian, 17040
crappie, white, 17211
croaker, Atlantic, 17160
dab, 17130
dace, 17079
dace, speckled X,
dace, longnose, 17079
shiner, redside, 17079
darter, johnny, 17078
eel, 17067, 17110, 17186, 17365, 17368
flounder, winter, 17263, 17298
gar, alligator, 17194
goldfish, 17038, 17140, 17146
grayling, 17090, 17125
hardhead, 17153
herring, 17096, 17319
Atlantic, 17127
blueback, 17239
lake, 17329
hitch, 17153
Huso huso, 17251
killifish, Rio Grande, 17378
Lampetra minima n. sp., 17189
lamprey, 17062
sea, 17279
Limanda limanda, 17332
menhaden,
Atlantic, 17065, 17264
Gulf, 17099
midshipman, northern, 17381
minnow, 17376
bluntnose, 17345
brassy, 17253

Specific, cont.
minnow, cont.
fathead, 17038, 17044, 17105, 17156, 17162, 17249
silverjaw, 17342
mosquitofish, 17153
mudminnow, 17120
mullet, 17312
mummichog, 17143
muskellunge, 17356
Oncorhynchus rhodurus macrostomus, 17209
perch,
European, 17344
white, 17338
yellow, 17046, 17059, 17297, 17318 17325, 17329
Percina crassa roanoka X Percina oxyrhyncha, 17200
pickerel, chain, 17349
pigfish, 17145
pike, northern, 17125, 17137, 17208, 17305
pikeperch, European, 17256
plaice, 17096, 17130, 17149, 17247, 17332
American, 17339
Plecoglossus altivelis, 17289
Poeciliopsis, 17328
pupfish,
Devils Hole, 17225
Red River, 17214, 17378
roach, California, 17153
Salmo mykiss, 17074
Salmo trutta morpha trutta, 17227
salmon, 17047, 17049, 17060, 17084, 17098, 17111, 17112, 17320, 17335, 17336, 17366
Atlantic, 17151, 17175, 17178, 17185, 17193, 17204, 17254, 17365
chinook, 17102, 17176, 17384
chum, 17174
coho, 17052, 17094, 17184, 17187, 17235, 17285, 17287, 17322, 17341, 17375
pink, 17109, 17245, 17322, 17324
sockeye, 17085, 17094, 17103, 17170, 17177, 17198, 17244, 17278, 17286, 17322
sauger, 17268
Seriola quinqueradiata, 17205, 17262, 17280
shad,
American, 17108, 17239
gizzard, 17145
shiner,
colorless, 17070
common, 17345
duskystripe, 17369
emerald, 17318

Specific, cont.
shiner, cont.
golden, 17153, 17355
mimic, 17345
sand, 17301
silver, 17316
silversides, Mississippi, 17050
snapper,
red, 17276
vermilion, 17276
sole,
bigmouth, 17082
curlfin, 17082
Dover, 17082
spot, 17160
squawfish, Sacramento, 17153
stickleback, threespine, 17068, 17207
sucker, 17329
Sacramento, 17153
western,
longnose, 17253
white, 17253
white, 17140
sunfish,
green, 17140, 17153, 17266
redear, 17266
Thymallus brevirostris, 17107
tilapia, 17197
tonguefish, California, 17082
trout, p7047, 17060, 17111, 17112, 17290, 17373

Specific, cont.
trout, cont.
brook, 17054, 17147, 17164, 17249, 17253, 17307, 17340, 17358, 17368
brown, 17164, 17184, 17192, 17216, 17253, 17270, 17323
cutthroat, 17164
lake, 17053, 17253, 17380
Lake Sevan, 17326
rainbow, 17041, 17051, 17058, 17066, 17069, 17116, 17118, 17128, 17133, 17136, 17153, 17155, 17164, 17167, 17169, 17172, 17184, 17188, 17196, 17202, 17204, 17205, 17215, 17220, 17229, 17237, 17243, 17248, 17252, 17253, 17260, 17621, 17271, 17272, 17281, 17282, 17292, 17296, 17327, 17333, 17337, 17343, 17353, 17354, 17363
sea, 17251
steelhead, 17049, 17084, 17243, 17283
turbot, hornyhead, 17082
walleye, 17224, 17268
whitefish, 17097
European, 17317
lake, 17288, 17304, 17329
ludoga, 17326
mountain, 17309
zebrafish, 17249

Stocking,
mysids, effects on Kootenay Lake and salmonids, 17047
salmon,
Atlantic, in New Hampshire lakes, 17254
coho, experimentally, in lake of N. Wisconsin, 17052
trout,
brown, in Gorzyn Lake, Poland, observation, 17192
hatchery-, effects on abundance of juvenile steelhead trout, 17243
rainbow, harvest, mortality and cost of 3 strains in large Calif. lakes, 17229

Survival,
bluegill, upper lethal temperature of, 17369
channel catfish virus, in chilled, frozen and rotting catfish, 17362
effect of heavy metals on fish, 17038
effects of,
Cd and Cu on lactate oxidation by trout gills, 17337
dibrom on stonefly, hellgrammite and shiner, 17355
dieldrin on brown trout, 17323
heavy metals on salmonid runs in Idaho drainage, 17084
metals on fertilization and development in fish, 17249
pollution on freshwater fish, 17334
residual chlorine on aquatic life, 17111
saline waters on fathead minnow in No. Dakota, 17156
entrainment of fish at power plants, harm to estuarine ecosystem, 17087
extinction, fish-, and acid water in southern Norway, 17061
fish,
and food organisms in acid mine waters, Pennsylvania, 17269
kills at Mactaquac Dam, re N supersaturation of water, 17365
nature and effect of seismic exploration, 17101

Survival, cont.
fishes, small-, stream-, effects of Floy-fingerling tags on, 17100
lampreys, nonparasitic-, of North America, reasons for protection, 17062
menhaden, Atlantic, 17264
mortalities, prespawning-, of Fraser River sockeye, ni-furpirinol (P7138) for control, 17244
mortality of 3 strains of tagged rainbow trout stocked in large Calif. lakes, 17229
oil-induced mortalities in juvenile coho and sockeye, 17094
salmon,
coho,
1965-66-brood-, from Columbia River hatcheries, 17187
stocked experimentally in N. Wisconsin lake, 17052
pink, Tsolum River, evaluation of gravel incubators re adult stage, 17324
shiner, duskystripe, upper lethal temperature of, 17369
thermal effects on bluegill eggs, larvae and juveniles, 17083
toxic,
effect of DBS- and TBS detergents on fishes, 17292
effects of aqueous aluminum to rainbow trout, 17167
toxicities, acute, of antimycin A, Bayer 73 and TFM to ostracods, 17360
toxicity,
acute-, of,
BKME to salmon, bioassay procedures, 17322
petroleum refinery effluents to fish, 17252
yellow phosphorus-contaminated diet to brook trout, 17147
chronic, of Cu-Cd-Zn mixture to fathead minnow, 17105
of,
alkylhydroxamic acids to salmon fry, re chain length, 17185
lead to rainbow trout, test of application factor concept, 17188
mixtures of metals and surfactants to trout, 17128
quinaldine sulfate to fish, 17081
oral-, of chlorinated dibenzofurans to juvenile salmon, 17175
testing of substances to fish, concepts and outlook, 17228
trout,
brook, in bog-derived acidity gradient, 17054
brown, stocked in Gorzyn Lake, Poland, observation, 17192
rainbow, re fin removal, 17260
upper-lethal temperature of Atlantic salmon, 17151
walleye, in Oneida Lake, cannibalism as factor in first year, 17224

Vegetation,
dense-, submerged-, technique for sampling fish populations in, 17367
higher marine shore plants of northeastern United States, 17199
macrophytes re ecology of pond 2 years after stocking of white amur, 17348
weed control,
by white amur, a controversial control, 17302
with grass carp in Lake Ösbysjön, 17275

Virology,
antiviral resistance induced in catfish by Poly I:C, 17088
cells, cultured-, FHM-, effect of temperature on division, RNA and protein synthesis, 17162
channel catfish virus,
and antibody, microcultures of bullhead cells used in quantitation, 17265
neutralization by serum of channel catfish, 17113
survival in chilled, frozen and rotting catfish, 17362
IHN virus, isolation and identification in eastern North America, 17237
IPN,
of Oncorhynchus rhodurus macrostomus, 17209
virus,
immunofluorescent study of replication in cell-cultures, 17204
neutralizing antibodies in trout, nature and activity, 17155

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of this department of natural resources.

The Department works to assure the wisest choice in managing all our resources so that each shall make its full contribution to a better United States now and in the future.